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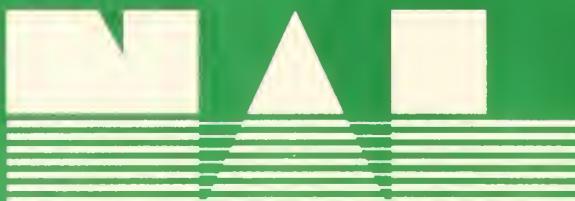
Hog Cholera and Its Eradication

A Review of U.S. Experience

United States
Department of
Agriculture

Animal and
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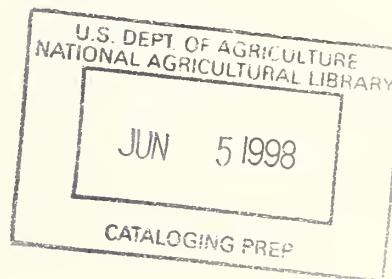
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Foreword

"Animal disease control and eradication are a condition of the mind"

—B. T. Simms

As this is written, in early 1979, it has been a year since the swine disease we call hog cholera was declared eradicated from the United States. It has been more than 2 years since the disease has been found in this country and 17 years since the Congress directed that hog cholera be eradicated.

Although the eradication effort was not formally authorized until 1961, attitudes toward the program were conditioned by over a century of prior experience with the disease. To be viewed in proper perspective, the story of hog cholera eradication must include what happened before 1961 as well as what has happened since.

No single document could include all these events. While the final achievement is essentially the story of people working together toward a common goal, it is not possible to recognize individually the many thousands that were involved.

Therefore, this publication is an overview, generally nontechnical, and certainly with many omissions. It is presented as a tribute to all those who helped wipe out a major livestock plague. They know what they did—and they know the satisfaction that comes with success.

G. H. Wise

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Chapter I

A Century of Coexistence (1833-1933)

"The one disease of farm animals which has gone on unchecked and which has baffled us in our efforts to develop a campaign that would seem to promise success, is hog cholera."

—USDA, Bureau of Animal Industry (1903)

Between the end of The American Revolution and 1790, thousands of people poured west into the rich lands beyond the mountains on the Wilderness Road laid out by Daniel Boone. In the next 30 years, by 1820, the United States doubled in population.

Sometime during the presidency of Andrew Jackson, somewhere in the newly settled Ohio River country, the disease we know as hog cholera was first noted. From there it spread throughout the United States and most of the world, killing more swine than any other infectious disease yet known. The appearance and spread of the disease at that time and in that area can be better understood against a background of the size and type of swine industry that had rapidly developed.

The Early U.S. Swine Industry

European swine were introduced into the Atlantic seaboard colonies in the early 1600's. George Washington, a dedicated farmer, has been credited with being the first to import highly bred swine. These animals came from the Duke of Bedford in England during the 1760's. This acquisition, along with later introductions, markedly improved the quality of animals available for swine production.

Swine moved west over the Appalachian Mountains with the waves of migration. People walked much of the way. Pigs walked all the way—both in getting to the new territory and in getting to market. Drovers sometimes journeyed hundreds of miles with their herds.

In the new territories hogs generally ran in the forest until a few weeks before slaughter, when they were put into cornfields to fatten. But it should not be concluded that swine were few in number or that the pork industry was unimportant.

Cincinnati had started to pack pork for distant markets by 1821. By the 1840's, the city was the largest pork market in the world, according to a contemporary report to Congress. The swine population of the United States in 1847 was estimated at 35 million, with 23 million slaughtered annually. The human population was then only about 20 million. In relation to potential domestic

consumers, the United States has less swine in the 1970's than it had in the middle of the last century.

This early explosion in swine numbers was due to corn marketing problems in the western farmlands, as illustrated by the following excerpt from the 1847 report of the Commissioner of Patents:

"The want of ready and cheap access to foreign markets led the settlers of the Western States to raising hogs and distilling whisky as a convenient means of taking corn, their greatest staple, in these shapes to market."

Further efficiencies resulted from using swine to dispose of distillery waste, and herds numbering in the thousands were maintained for this purpose.

Far from being a sparsely settled area of isolated frontier cabins, the States bordering the Ohio River were home to a large concentration of swine by the 1830's and 1840's. Such an environment was conducive to the spread of disease.

Emergence of Epizootic Disease

In the fall of 1887, the Bureau of Animal Industry of the United States Department of Agriculture (USDA) tried to reconstruct the history of the origin and spread of what was by then being called hog cholera. Correspondents throughout the country were queried concerning swine disease problems. More than a thousand replies were received, some in great detail. This mass of information, while retrospective, is the most authentic overview available of swine disease problems in the first two-thirds of the 19th century. From this survey, and isolated published reports during these early years, a picture emerges of the sudden appearance and rapid spread of an acute swine disease with high death losses.

Prior to the emergence of this epizootic disease during the 1830's, swine illnesses were not a marked problem. Losses were described as generally confined to a single animal at a time.

While the first outbreak of the condition supposed to be hog cholera was reported to have been in Ohio in 1833, only 10 outbreaks—in 10 different States—were recalled by correspondents from 1833 to 1845.

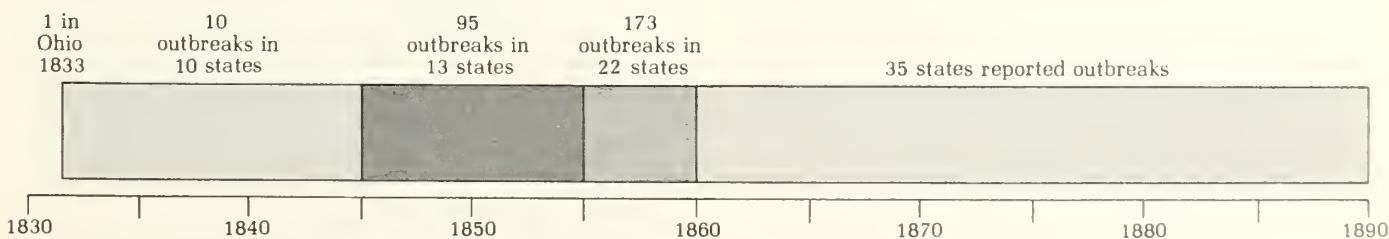


Figure 1-1.—Reports of hog cholera, 1830-90.

As these States ranged from the eastern seaboard to the Gulf of Mexico and north to Indiana, it seems evident that while the disease had spread widely it was not recalled as being the cause of massive outbreaks.

The situation changed rapidly in the next 10 years. From 1846 to 1855, correspondents recalled 95 outbreaks in 13 States. From 1856 to 1860—5 years—173 outbreaks were remembered in 22 States. By 1887, the disease had been reported in 35 States, from Maine to Texas to California. (Fig. 1-1.)

Losses became enormous. A Buffalo newspaper mentioned a distiller in western New York who lost 1,400 head in 1857 (and was further incensed at the \$1,000 it cost him to get them buried). The distillery at New Richmond, Indiana, lost 11,000 animals in the summer and fall of 1856. In 1857, the American Veterinary Journal reported the death of over 60,000 hogs within a 100-mile radius of Cincinnati from "a destructive disease." The Bureau of Animal Industry has estimated deaths from hog cholera in 1886 at over 13 percent of the swine population.

Origin of the disease was debated. The Bureau speculated that it was "reasonable" that the contagion was imported from Europe. European authorities considered it more reasonable that the disease originated in the United States. The eastern States blamed the disease on hogs imported from western States. In any event, the stunning impact on the swine industry resulted in demands to Washington for action.

Early Studies

As swine deaths mounted and the disease spread, studies by individual investigators were published. Two physicians, George Sutton and E. M. Snow, worked on the problem in the decade prior to the Civil War. Sutton recorded many of the large losses previously mentioned, described the disease, and studied the possible effect on human health. Snow, in addition to interest in the extent of spread, described the symptoms and lesions. Another early investigator, a New York veterinarian named James Law, conducted experiments in swine and other species during the 1870's. He observed that freezing would preserve virulence, noted the small hemorrhages often found in affected swine, and reported successful transmission to sheep and rabbits.

In 1878, Congress appropriated \$10,000 to study diseases of domestic animals. The Commissioner of Agriculture, who in 1877 had reported that two-thirds of the contagious disease loss in livestock

was in swine, prudently decided to spend most of the money on swine disease investigations.

Investigators from nine States were appointed, including Dr. Law and another veterinarian, Dr. D. E. Salmon of North Carolina, who later became the first Chief of the Bureau of Animal Industry. Their studies, carried out in various parts of the country, resulted in many reports from 1878 to 1883.

Their findings were summarized in 1962 by the Agricultural Research Service of USDA in a historical review of hog cholera research:

- One disease prevailed as an epizootic.
- A destructive swine disease was occurring in widely separated parts of the country.
- Investigators described the disease in similar fashion.
- Most believed the disease was both communicable and contagious.
- No remedies tested were of demonstrable value in treating illness or protecting against infection.

The problem was apparently narrowed to a single entity, but the cause was unknown and no one knew what to do about it. Losses continued and so did pressure on the Government. In 1884, Congress established a Bureau of Animal Industry within USDA. As a primary reason for this action was the impact of hog cholera, the Bureau immediately embarked on an intensive research program on the disease.

Research Leads—Disappointing and Rewarding

By 1885, hog cholera had been spreading for over 50 years. Little had been learned of this or other swine illnesses. Within 20 years, Bureau scientists isolated the causative agent, developed an effective antiserum, and set the stage for a method of immunization. While false leads were pursued and disagreements arose, the many successes in those years probably saved the swine industry and made possible its continued growth in size and complexity during the 20th century.

Salmon and his coworkers first set out to identify the organism causing hog cholera or swine plague (there was still argument over terminology). In France, Pasteur had prepared a vaccine against "rouget"—a disease causing great damage in European swine. The Bureau obtained the Pasteur vaccine and in 1886 reported that it would not protect against the American disease; the United States had a different problem. (We now know "rouget" as swine erysipelas.)

A consequence of this study was that two sick farm pigs, brought to Washington from New Jersey

to challenge by contact the test pigs inoculated with Pasteur's vaccine, started an acute disease outbreak in the Bureau's experiment station. However, reported Bureau Chief Salmon, this outbreak "finally enabled us to demonstrate as the cause of the disease a specific microbe." This microbe was subjected to a variety of animal studies which led Salmon to conclude that the organism was the cause of the U.S. swine disease problem and that the illness produced by the organism should properly be called hog cholera.

For several years, work continued on the bacterium accepted as causing hog cholera. A Board of Inquiry appointed in 1888 agreed that the disease being called hog cholera was produced by Salmon's "hog cholera germ," and strongly recommended studies on possible vaccines. For 10 years, serums were produced and vaccines were tested, including field trials in Iowa. Although field trial results were equivocal, and some investigators noted that large numbers of the pure "hog cholera germ" could be injected without producing illness, belief persisted that the causative agent had been found.

Two Bureau scientists, Alexander deSchweinitz and Marion Dorset, finally concluded that experimental results and field observations did not match. By 1903, they had filtered out bacterial cells from infective blood and had found that the filtrate produced hog cholera. As their Chief, Dr. Salmon, had been credited for many years with discovering the bacterium causing hog cholera, they understandably noted their find with great restraint. Thus, their report stated that "there is an infectious disease among hogs in this country which cannot be distinguished clinically from hog cholera, and which may be reproduced by infecting with material containing no hog cholera bacilli." Dr. Salmon, at first critical, soon accepted their work, which was later confirmed by other investigators in the United States and other countries. Hog cholera was caused by a virus.

Dr. deSchweinitz died in 1904. Dorset and coworkers carried on the effort to find a way to protect swine against hog cholera. Vaccines prepared from infective blood were not successful. They then directed their efforts to developing hyperimmune serum by injecting known immune animals with increasing amounts of blood from sick swine. By 1906, they learned that hyperimmune serum could be produced, that such serum administered alone to susceptible pigs protected for only a short time, and that hyperimmune serum administered simultaneously with disease-producing blood resulted in lasting protection. Their method of producing serum was patented by the Government,

with all rights dedicated to the public.

Eighty years had passed since the first reports of hog cholera. For the first time swine raisers had a positive means of insurance against being wiped out by the disease.

The Rush to Immunization

The dramatic developments of 1903 to 1906 received great press attention. Pressure developed for quick release of the procedure for field use. The Bureau started demonstration sessions in 1908. By 1912, 30 States were distributing serum which they either produced or purchased from the rapidly increasing numbers of commercial serum producers.

It soon became evident that proper production controls were needed. In 1913, following passage of enabling legislation, the Bureau initiated inspection of serum production.

Area demonstration projects were started in 1913, and in 1914 covered 17 counties in various parts of the country. As could be expected, field results showed that serum alone was not as effective in preventing the disease as was simultaneous use of serum and virus. These trials resulted in several conclusions, one being that the value of hog cholera immunization had been demonstrated and another—of considerable foresight—that eradication of hog cholera would require many years of effort and that no plan promising a reasonable hope of success could be suggested.

By 1915, the swine industry was committed to a system of protection that offered insurance against devastating loss—a system that provided a way to "live with" hog cholera, but not a way to eliminate the disease. (Fig. 1-2.)

The Road to Continued Coexistence

The U.S. livestock industry and State and Federal agencies concerned with animal health have long taken the position that it is sound economics to eliminate major animal diseases. This philosophy has been demonstrated by successful actions starting with the eradication of contagious bovine pleuro-pneumonia in a program begun in the 1880's and concluded in 1892. Foot-and-mouth disease was stamped out on the several occasions when it was introduced. Programs to eliminate cattle tick fever and dourine and glanders in horses were started in the early 20th century and successfully concluded. Yet, in spite of losses greater than for any of these, hog cholera was not subjected to this kind of attention until after World War II. The reasons for

this exception to the general policy lay in the nature of the disease and its impact on U.S. agriculture.

In 1903, the Bureau of Animal Industry, commenting on an estimated \$50 million annual loss from hog cholera, stated that ". . . the losses from the disease are accepted as one of those inevitable things that cannot be escaped . . ." The report went on to say that "this disease is one of the most difficult, from a scientific point of view, that has been investigated and much time is required to establish facts concerning its nature."

There had been attempts to demonstrate how to eliminate hog cholera. In the 1890's, a field eradication effort was mounted in Iowa. It failed—the disease was too widespread, moved too fast, and not enough was known about it. In 1913, with the advent of hyperimmune serum and virus, the Bureau got \$75,000 from Congress to demonstrate the best method of preventing and eradicating hog cholera. This went for the field demonstration projects on virus-serum usage. By 1917, when the projects were ended, eradication was no longer mentioned as of primary importance and Bureau



Figure 1-2.—Vaccinating a pig against hog cholera. Immunity was induced through simultaneous injection of virulent virus and anti-hog cholera serum.

reports on hog cholera for the next 30 years did not refer to eradication. The emphasis was in research on immunizing agents and the need for more swine raisers to use such agents to protect their herds.

The newly discovered means of protection required not only hyperimmune serum, but also the simultaneous use of blood which of necessity contained living hog cholera virus. Whether or not it was understood by swine raisers that use of this protection system also perpetuated the disease is not now clear. Reports of the Bureau during that period did not stress this consequence.

It is clear, however, that this was understood in Canada; and U.S. scientists certainly must have had similar perception. Nevertheless, differing experience with hog cholera between the two countries resulted in differing attitudes and markedly different public policy on handling the problem.

During the first 20 years of the 20th century—a time when the U.S. swine industry was moving rapidly into widespread use of serum and virulent virus—Canada embarked on an eradication program. By 1900, infected herds in Canada were being destroyed and indemnity paid. Feeding uncooked garbage to swine was recognized during the 1890's as the cause of some Canadian outbreaks; and legislation requiring cooking of such garbage was enacted in 1916. A key decision, in 1913, was the prohibition of both importation and manufacture of hog cholera vaccines. With these actions and in spite of importation of swine and pork products from the United States, Canada has successfully maintained a stamping-out policy.

But Canada did not have to deal with hog cholera until 1885—50 years after the disease started spreading in the United States. In this country, the advent of a method to prevent infection was a means of saving the swine industry.

USDA has estimated that deaths of U.S. swine from hog cholera in the 30 years from 1884 to 1913 averaged 7.5 percent annually, with 6 of those years over 10 percent and no year under 4 percent. As this "average" presumes an even spread over the entire population—which was not the case—the impact in infected areas was catastrophic. The reality of early stories from regions of heavy swine concentration of seeing smoke from burning hog carcasses rising from farms all across the landscape can be readily understood.

The discovery of virus-serum treatment gave U.S. swine raisers a way for the individual to protect his herd against these huge losses. To the producer of 1913, this opportunity must have seemed to be all that could be expected or needed. While the

development of this means of protection was a discovery of USDA—and USDA thus had an interest in promoting its use—it is unlikely that any caution expressed on future problems would have had much impact. Indeed, given the situation facing the swine industry, it was probably necessary to capitalize on any opportunity for prompt relief.

Hog Cholera After Virus-Serum Adoption

By 1918, the use of serum and virus had been widely demonstrated. Serum production had risen from 208 million c.c. in 1915 to over 500 million c.c., with virus production rising correspondingly. A billion c.c. of serum was produced in 1927 (a year with widespread hog cholera) and annual production generally stayed over a billion c.c. until the advent of other vaccines in the 1950's.

It seems certain that use of the virus-serum method of immunization greatly reduced the level of hog cholera in the United States. USDA estimates show that the last large-scale epizootic (over 9 percent deaths) was in the 1912-13 period when virus-serum use had not yet become established. As previously noted, the estimated annual death rate in the 30 years prior to 1914 averaged 7.5 percent. During the 25-year period from 1915 to 1940, the estimated average annual death rate dropped to 3.6 percent. (Fig. 1-3.) The wide cyclic swings seemed to

level out. In only 1 year, 1926, did the disease show a rapid upswing—to 5.8 percent. Outbreaks (infected herds) reported to the Bureau from 1920 to 1940—with the exception of 1926—ranged from a high of 9,788 in 1920 to a low of 2,256 in 1932. As hog prices during the depression years were poor (3.3 cents per pound in 1932), it may be that less attention was paid to disease—and to reporting.

It should not be concluded, however, that all swine received serum and virus. Most swine raisers decided against the investment. Bureau reports for the 1920's stressed the need for higher coverage, and just prior to the fall and winter outbreak of 1926 the Bureau estimated that 80 percent of U.S. swine were not protected against hog cholera. But it does appear that the level of use—concentrated largely in heavy swine producing areas—did reduce the number of outbreaks and prevented the large upswings in incidence that previously occurred.

Vaccine Studies Resumed

An unfortunate side effect of the concentration on perfecting and promoting the virus-serum method of immunization was a diversion of research effort away from vaccine studies. Early attempts to develop a vaccine, started by Bureau scientists shortly after hog cholera virus was discovered, were abandoned and not resumed for over 25 years.

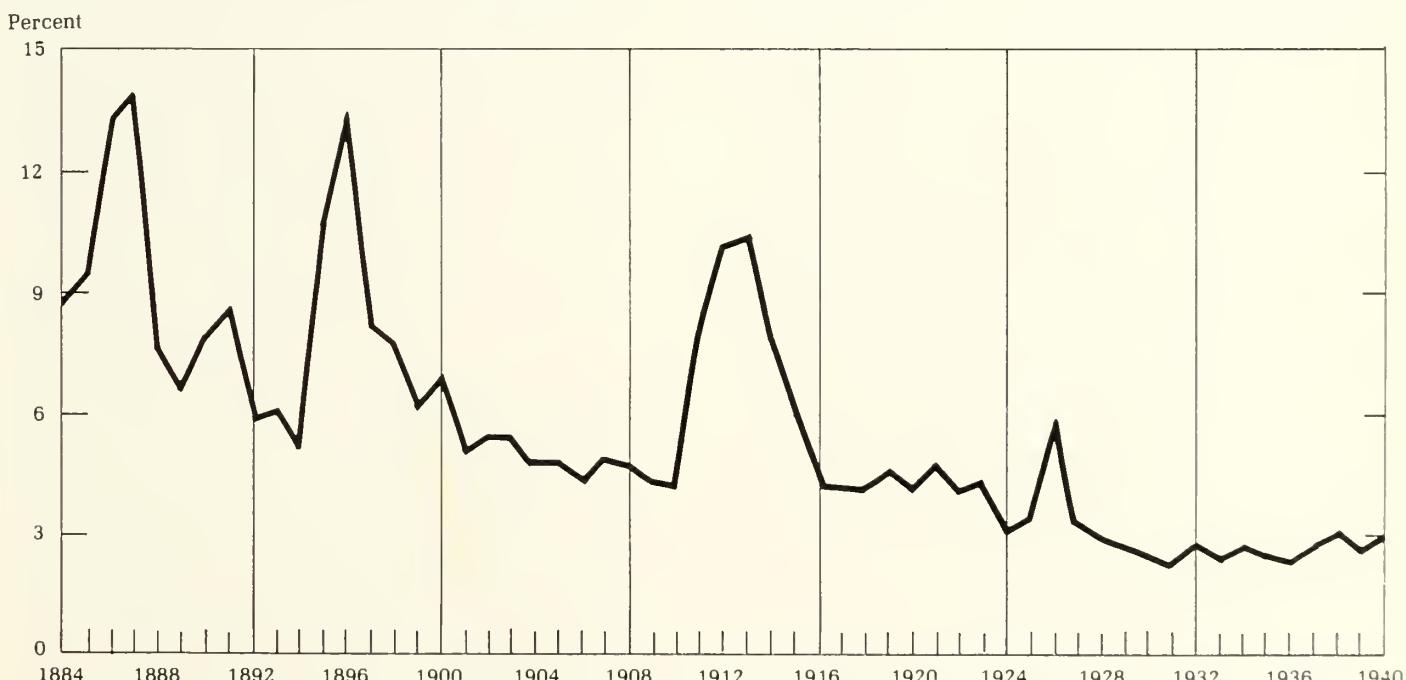


Figure 1-3.—Estimated death losses of hogs from hog cholera in the United States, 1884-1940.

However, as experience with serum-virus use was accumulated, it became evident that the procedure was not without problems. "Breaks" occurred in which hog cholera developed in treated pigs. These breaks were found to be due to a variety of factors, including exposure prior to treatment, insufficient serum dosage, and lowered resistance at time of treatment from concurrent disease or parasitism. Herds that broke following treatment provided an additional source of exposure to susceptible swine with which they came in contact. To a considerable degree, hog cholera research was concentrated on defining and solving the problems that arose.

And, in spite of the pronounced benefits from virus-serum treatment, hog cholera continued to take a significant toll. Because of cost and other problems that could arise, many producers did not use the procedure. Their herds were ripe for infection from naturally occurring disease or from exposure to virus shed by animals not responding satisfactorily to immunization. Millions of doses of virulent virus were distributed throughout the

country each year. This virus, unless properly handled, provided an additional means of spreading the disease.

As a consequence, interest in alternatives rose. Research efforts concentrated on finding an inactivated vaccine, in which the virus was presumably rendered innocuous while retaining immunizing ability. By the early 1930's, there were indications of favorable results. In 1933, W. H. Boynton published his work on an inactivated vaccine. Bureau of Animal Industry scientists were also working with several processes. In 1934, Marion Dorset, who 30 years earlier had been a codiscoverer of hog cholera virus and who had produced the first hyperimmune serum, used crystal violet dye as a virus-neutralizing agent with good preliminary results.

With these promising developments, it became possible to envision immunizing agents of increased safety that would permit hope for eventual eradication of the disease.

"We have the means to stamp out hog cholera, would we but use them"

—J. P. Torrey (1956)

The Change to Vaccines

Development of new hog cholera vaccines was not easy. A variety of agents were tested for ability to destroy the infectivity of the virus while retaining the immunizing potential. Many of the experimental vaccines produced quite high levels of protection, although results were erratic for some. Others resulted in tissue irritation or had undesirable physical characteristics. In spite of these problems, however, it is likely that many of these products would have been received with enthusiasm if they had been discovered 30 years earlier. Successful virus-serum treatment, however, produced protection levels well over 90 percent. Any alternative method had to compete against this established high standard.

Marion Dorset died in 1934, shortly after his initial promising results with the crystal violet vaccine. His coworkers continued, and in 1936 C. N. McBryde and C. G. Cole published a progress report in the Journal of the American Veterinary Medical Association. In 1937, W. H. Boynton and his associates published the first of several articles on their work on an inactivated hog cholera produced by treating infected swine tissues with glycerin and eucalyptol.

Field tests of both crystal violet vaccine and the Boynton tissue vaccine showed value in protecting against hog cholera. Commercial production of these vaccines in the United States began in the 1940's.

The inactivated vaccines had some drawbacks when contrasted with serum and virus. Development of immunity took up to 3 weeks, so they would not protect against immediate exposure in infected neighborhoods. The duration of immunity was less. The vaccines could not be used simultaneously with serum and still be as effective in producing immunity. In addition, tests with crystal violet vaccine showed that two doses were required in order to approach the high level of protection afforded by serum and virus.

But these vaccines had one strong advantage—safety. While there was discussion over whether or not all virus particles in the vaccines were truly "dead," in field use it was possible to administer the products without any real fear of introducing or spreading hog cholera. Consequently, they could be used safely in part of a herd or in hog cholera-free districts. They did not lower the general resistance of the animal, so could be used on pigs that might be harboring other illness. They provided a safe way for swine breeders in noninfected areas to produce immunity in young stock to be sold into infected areas.

The inactivated vaccines provided a useful alternative to serum and virus, and thus demonstrated the possibility of moving away from the perpetual cycle of living with the disease that was inherent in the continued use of the simultaneous method.

However, while the inactivated vaccines filled a need in the United States, they did not reach the levels of acceptance and use achieved in many other countries. U.S. swine producers and their veterinarians generally did not utilize the inactivated products as a substitute for the simultaneous treatment. What was needed were products that were safer than serum and virus and could produce prompt, long-lasting protection.

Following World War II, techniques developed in producing a vaccine against rinderpest—a devastating cattle disease in Asia and Africa—were applied to studies on hog cholera virus. In 1946, two research papers, published in the same issue of a scientific journal, reported that serial passage of hog cholera virus through rabbits reduced virulence. This work, done independently by J. A. Baker and by H. Kaprowski and coworkers, opened the way to a new series of hog cholera vaccines that could compete directly with serum and fully virulent virus.

Commercial vaccine producers moved quickly to capitalize on this information. While several basic methods evolved, all involved altering or attenuating hog cholera virus by serial passage through rabbits or through porcine cells. The resultant virus, still living, was reduced in its ability to cause hog cholera, but it still was able to stimulate immunity.

The modified virus was obtained in quantity for production by harvesting from either swine, rabbits, or cell culture. Such vaccines varied in the amount of reduction of virulence from the original virus. While all could be used simultaneously with hyperimmune serum to achieve immediate protection, some had to be used with serum in order to prevent sickness in vaccinated swine.

The first commercial license for modified live virus vaccine was issued by USDA in 1951. Additional licenses soon followed. The time was right for public acceptance. In 1949 and 1950, hog cholera had broken out in some herds shortly after they had received simultaneous serum and virus treatment. While it was rapidly established by the Bureau of Animal Industry that these breaks were due to a variant hog cholera virus that had unknowingly been used in some commercial virus production, the situation was alarming to swine producers. With this, and the wide publicity given to the modified virus vaccines, large numbers of

producers and veterinarians turned to these products. The swing away from serum and virus was rapid. By 1956, two out of three swine treated against hog cholera received vaccines. Modified live virus vaccines accounted for over 90 percent of the vaccines used, with inactivated products making up the balance.

Interest in removal of fully virulent virus started with the advent of the modified vaccines. Alabama, in 1954, was the first State to take this action. Twenty-nine States had done so by mid-1959. (Fig. 2-1.)

This rapid transition was not without problems. The inactivated vaccines could not be used under the same conditions of exposure as could serum and virus. The modified live virus vaccines, contrary to some of the early hopes, could not be used indiscriminately with no precautions. With some, simultaneous use of serum was necessary if trouble was to be avoided. Proper quantities of properly handled vaccine and serum were needed. The vaccine virus, while reduced in virulence, was still a living agent and required understanding and caution in its use. Correct procedure for one type of modified live virus vaccine would not necessarily produce good results with another. Problems with pregnant sows were being reported. However, the benefits of the new products were so evident that, in spite of some problems, they largely supplanted the old method in a short period of time. With this action, one of the greatest bars to eventual eradication was lifted.

Organizing for Eradication

With the advent of "safer" vaccines came renewed interest in the possibility of eradicating hog cholera from the United States. In the fall of

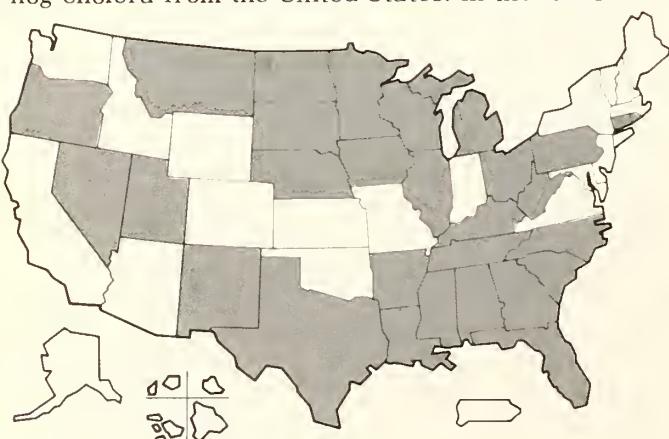


Figure 2-1.—By June 1959, 29 States had prohibited the use of virulent hog cholera virus.

1950, the Executive Committee of the American Veterinary Medical Association sent a resolution to the United States Livestock Sanitary Association (USLSA) stating that hog cholera could properly be considered an eradicable disease, and endorsing formation of a representative committee aimed at a nationwide eradication effort.

The USLSA—now the United States Animal Health Association (USAHA)—is largely made up of State and Federal animal health officials, livestock industry people, and research scientists. It maintains a number of committees devoted to particular interest areas. In 1951, the USAHA established a Committee on the Nationwide Eradication of Hog Cholera.

The 22 original members of the committee represented farm organizations, veterinary research, swine producers, the farm press, the veterinary biologics industry, and the State and Federal Governments. The committee's first report stressed that virulent virus should be eliminated; it made recommendations for handling outbreaks, for use of immunizing agents, and for research. The bulk of the report, however, was devoted to the need for a massive public education program concerning hog cholera, its cost, and the methods and benefits of eradication. The committee believed that technical knowledge was available, but that public interest and awareness were lacking.

During the early 1950's, as the committee was trying to stimulate interest in hog cholera eradication, another swine disease swept across the country that was to have significant impact on the handling of hog cholera.

In 1932, a disease at first thought to be foot-and-mouth disease broke out in garbage-fed hogs in California. By 1934, it was determined that the illness, indistinguishable clinically in swine from foot-and-mouth disease, was in reality a new disease of swine never before reported. Named vesicular exanthema (VE), it remained confined to California for 20 years, with over 95 percent of the outbreaks occurring in hogs fed garbage.

In June 1952, a transcontinental train moving east from California left dining car garbage in Cheyenne, Wyoming. This garbage was later fed to hogs. These animals, by movement through stockyards, introduced vesicular exanthema east of the Sierras. Within 2 months, the disease had been reported from 19 States. By September 1953, a total of 42 States and the District of Columbia were infected. Most of the outbreaks were in garbage-fed swine.

It had been long known that uncooked garbage containing raw scraps of pork from diseased swine was a prime means of spreading hog cholera and

other diseases, but no State or Federal regulations existed prior to 1952 that required sterilization of garbage by heat prior to feeding to swine.

As vesicular exanthema looked like foot-and-mouth disease, its continued presence might mask an introduction of that dreaded disease. Therefore, an eradication program was launched against vesicular exanthema. It was a crash effort and was rapidly successful. The last cases were detected and eliminated in 1956 in New Jersey. Vesicular exanthema was declared eradicated in 1959.

This campaign was important to the future possibility of hog cholera eradication. State regulations were adopted requiring the cooking of garbage fed to swine. Federal regulations were adopted that severely restricted interstate shipment of swine fed raw garbage and pork products from such swine. The swine industry, for the first time, was heavily involved in a rigorous nationwide disease eradication program and learned the measures necessary to achieve success. Veterinarians in State and Federal animal health agencies developed a close working relationship with leaders in the swine industry—and this became a key factor in moving toward a national hog cholera eradication effort.

During the years of the vesicular exanthema program, the USAHA committee had continued to work. An informative booklet on hog cholera was published. A pilot test area was started in Florida to demonstrate the value of recommended control procedures, including vaccination. In 1956, the committee published a nine-point program for hog cholera eradication and urged USDA to establish a staff section and set aside funds for eradication.

In 1958, Livestock Conservation, Inc. (LCI)—now the Livestock Conservation Institute—a national organization of livestock producers and allied groups, formalized industry interest by establishing a National Committee for Hog Cholera Eradication. In its initial years, the LCI group adopted the nine-point program, started the formation of State-level hog cholera eradication committees, and worked with USDA in sponsoring regional workshops.

The Curtain Raiser—Federal Legislation

By 1960, it was evident to those working to develop an eradication program that Federal commitment was needed if further progress was to be made. Farm organizations and other interested groups sent representatives to a strategy discussion in Washington, D.C. It was decided that although existing legislation contained sufficient broad authority to enable Federal participation in a hog

cholera eradication effort, specific action by the Congress would best demonstrate immediate and direct support for what was bound to be a difficult program.

Discussions with members of Congress were initiated. These led, in the spring of 1961, to introduction of legislation in the Senate and House to provide for a national eradication program. Shortly thereafter, the Senate Committee on Appropriations requested from the Secretary of Agriculture a statement on the feasibility and estimated cost of such a program.

The Secretary, in responding, outlined the recent changes in vaccination practices that favored initiation of an eradication program, listed the steps necessary, and reviewed the broad support for the program among farm organizations and allied groups. The report estimated a first year Federal program cost of \$4 million, rising to about \$10 million during the succeeding 4 or 5 years. States, as in other animal disease programs, were expected to bear their share. The Secretary stressed that hog cholera was costing the United States an estimated \$40 to \$60 million a year, not including loss of foreign markets. Costs of vaccination alone were estimated to be 45 cents per pig marketed, in contrast to Canada where an estimated cost of 1 cent per pig marketed maintained their eradication program over a 45-year period.

On September 6, 1961, President Kennedy signed Public Law 87-209, an act to provide for a national hog cholera eradication program. The vote in both Houses of Congress had been overwhelmingly in favor of passage. (Fig. 3-1.)

Public Law 87-209

AN ACT

To provide for a national hog cholera eradication program.

September 6, 1961
[S. 1908]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, in order to safeguard the health of the swine herds of the Nation, to prevent the spread of hog cholera, to decrease substantially the estimated \$50,000,000 annual loss from hog cholera, to expand export markets for pork and pork products now restricted on account of hog cholera, and to otherwise protect the public interest, the Secretary of Agriculture is hereby directed (1) to initiate a national hog cholera eradication program in cooperation with the several States under the provisions of section 11 of the Act of May 29, 1884, as amended (21 U.S.C. 114a), and related legislation, and (2) to prohibit or restrict, pursuant to the authority vested in him under the provisions of section 2 of the Act of February 2, 1903, as amended (21 U.S.C. 111), the interstate movement of virulent hog cholera virus or other hog cholera virus to the extent he determines necessary in order to effectuate such eradication program.

Agriculture De-
partment.
Hog cholera,
eradication pro-
gram.

70 Stat. 1032.

32 Stat. 792.

SEC. 2. (a) The Secretary of Agriculture is authorized and directed to establish an advisory committee composed of (1) eleven members selected from representatives of the swine and related industries, State and local government agencies, professional and scientific groups, and the general public, and (2) one member selected from the officers and employees of the Department of Agriculture who shall serve as chairman of the Committee. The Committee shall meet at the call of the Secretary.

Advisory Com-
mittee.

Function.

(b) It shall be the function of the Committee to advise the Secretary with respect to the initiation of the national hog cholera eradication program referred to in the first section of this Act, and with respect to the development of plans and procedures for carrying out such program.

(c) Committee members other than the chairman shall not be deemed to be employees of the United States and shall not be entitled to compensation, but the Secretary is authorized to pay their travel and subsistence expenses (or per diem in lieu thereof) in connection with their attendance at meetings of the Committee.

Expenses of
members.

Approved September 6, 1961.

Figure 3-1.—On September 6, 1961, President Kennedy signed Public Law 87-209, which authorized a national hog cholera eradication program.

The Act was short. It directed the Secretary of Agriculture to initiate a national program in cooperation with the States and to prohibit or restrict the interstate movement of virulent hog cholera virus or other hog cholera viruses as necessary to carry out such a program. The act also directed the Secretary to establish an advisory committee to advise him on initiating and carrying out the effort. Members were to be drawn from the swine and related industries, State and local governments, professional and scientific groups, and the general public.

After more than a century of trying to find ways to live with hog cholera, the decision had been made to eliminate the problem.

Chapter III

The Final Assault (1961-77)

"... The Secretary of Agriculture is hereby directed to initiate a National Hog Cholera Eradication Program in cooperation with the several States..."

—Public Law 87-209, 87th Congress; Approved September 6, 1961

By 1960, swine husbandry practices in the United States were changed markedly from those practiced in the early 1800's. In 1830, just prior to the first reports of hog cholera in the Ohio River area, there were only 23 miles of railroad in the country. By 1870, there were over 50,000 miles of track. By 1916, with 250,000 miles of rails, fat hogs were moving long distances to terminal markets surrounded by large packing houses. After World War I, rail transport was augmented by the mushrooming highway system built to carry automobile and truck traffic. Hundreds of smaller livestock markets bought and sold swine brought in by truck, some from considerable distances away.

These improved transportation systems enabled many producers to concentrate on raising feeder pigs for sale to others for fattening. Young pigs could, and often did, move through several assembly points and end up for final finishing far from where they were born.

While these developments improved the efficiency of swine production, they also provided an efficient means for dissemination of disease—as was illustrated in the rapid nationwide spread of vesicular exanthema of swine in 1952-53.

To this difficulty was added the fact that USDA and the States, faced with planning a national hog cholera eradication program, did not have accurate information about the location and frequency of the disease. The commonly accepted figure of 5,000 to 6,000 hog cholera outbreaks a year was largely informed guesswork; as late as 1962, only 10 States had established systems for immediate reporting of the disease.

While it was believed that hog cholera had dropped in volume with the advent of the improved vaccines, the only factual evidence for this was indirect, coming from Federal meat inspection reports. Condemnations for hog cholera on slaughter inspection, which in the late 1940's exceeded 1,000 for 10,000,000 swine slaughtered, dropped to about 300 per 10,000,000 by 1960.

There was no doubt, however, that the disease was still costly. This was summed up by H. W. Dunne, editor of a standard text on swine diseases and a recognized international authority on hog cholera, who stated at the 1961 symposium on hog cholera at the University of Minnesota that "... it cannot be denied that hog cholera is still the biggest killer of swine of any specific disease now known in that species."

Program planning had to proceed based on the information then available. Key factors, evolved in the early months and years of the campaign, were a phased approach based on the disease situation in a

particular State, establishment of long-range national goals for completion of each phase, and the interlocking efforts of three national committees representing the States, the industry, and USDA.

The Four-Phase Program

In 1960, the Committee on the Nationwide Eradication of Hog Cholera of the USAHA issued a booklet, "What you Should Know About Hog Cholera," that contained nine points that became widely accepted as the basis for actions necessary in the forthcoming program. These points, refined from a list first stated by the committee in 1956, largely concerned basic principles necessary in any animal disease eradication effort. (Fig. 3-2.) The fact that the committee felt it necessary to call attention to these in detail in relation to hog cholera indicates the previous lack of attention to organized controls over the disease.

This "Nine-Point Program," which became the foundation for planning the four phases of the national effort, was as follows:

- Eliminate virulent hog cholera virus
- Prohibit feeding of raw garbage to swine
- Require reporting of known or suspected outbreaks
- Quarantine infected premises
- Increase vaccination against hog cholera
- Control movements of swine
- Clean and disinfect vehicles and infected premises
- Intensify hog cholera research
- Institute a long-range information and education program.

In October 1962, the USAHA met in Washington, D.C. Thirteen months had passed since passage of the Federal legislation enabling a national program. Georgia had taken its own action in April, having started an eradication program in several counties that included payment of indemnities. Nationally, the USDA Advisory Committee called for in the law had been organized. The first Federal funds to support the program had become available in the summer of 1962. The Animal Health Division of USDA had worked with representatives of the States to draft a proposed national program structure.

At the Washington meeting in October, the USAHA and USDA agreed on a nationwide cooperative State-Federal program divided into four phases. While the specifics of each phase were

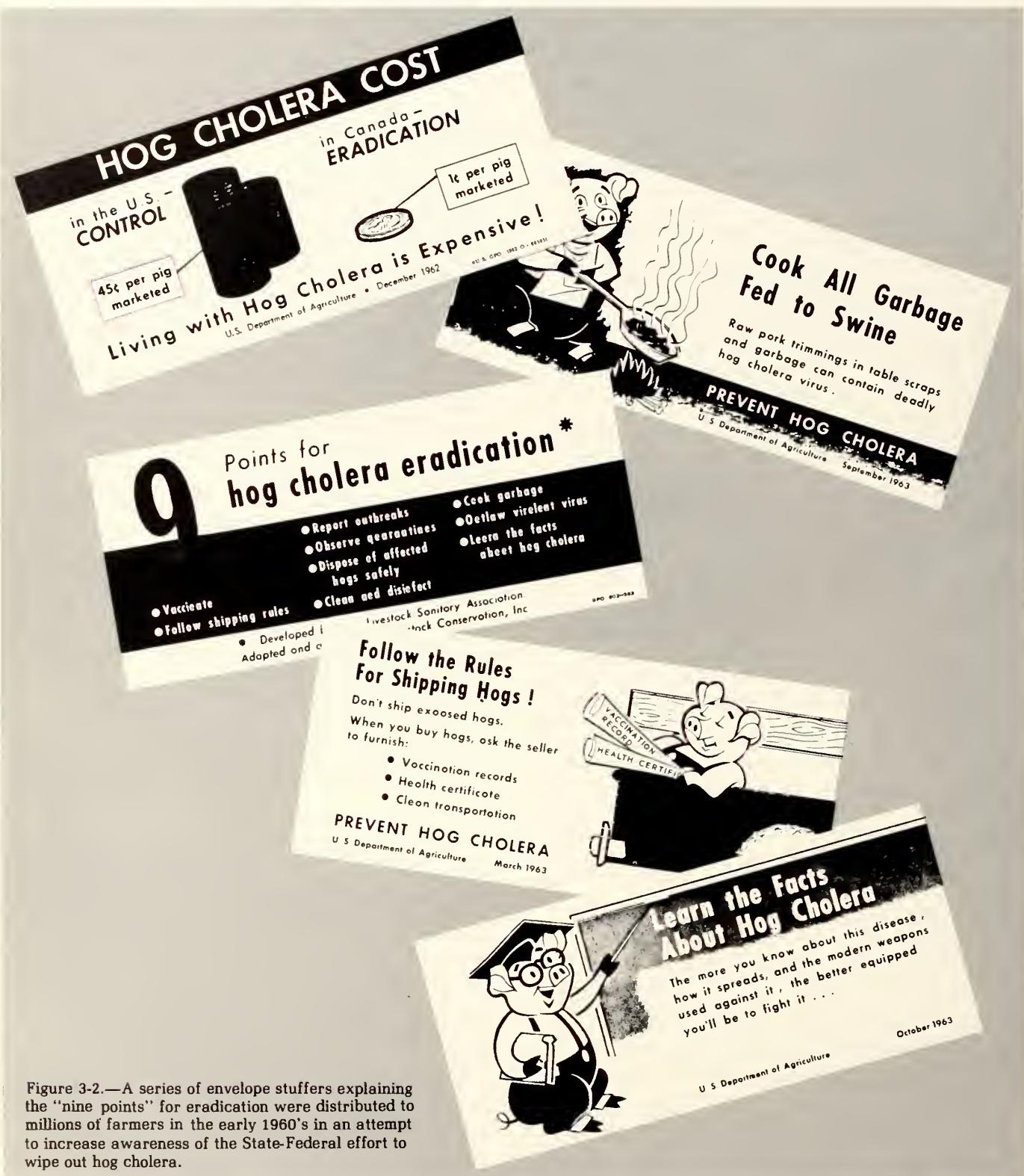


Figure 3-2.—A series of envelope stuffers explaining the "nine points" for eradication were distributed to millions of farmers in the early 1960's in an attempt to increase awareness of the State-Federal effort to wipe out hog cholera.



uniform nationwide, each emphasized a different level of effort, thus permitting a State to enter the program and progress further according to individual conditions. The four-phase program remained the foundation of the campaign in succeeding years.

The title of each phase stated the main objective of that stage. These, and the primary points to be met before a State could enter the program or advance to the next phase, were as follows:

Phase I—Preparation

State authorities in existence to require reporting of hog cholera, cooking of garbage fed to swine, regulate swine movement, quarantine, inspect, and disinfect infected premises, and control use of hog cholera biologics.

- Establishment of State and county hog cholera eradication committees.
- Establishment of a system for prompt reporting of suspected outbreaks.
- Investigation of reported suspicious outbreaks.
- Disposition of each report through a standard diagnostic procedure.

Phase II—Reduction of Incidence

- Quarantine of suspect herds until final diagnosis and maintenance of quarantine on infected herds as long as danger to other herds remained.
- No movement from quarantined herds except to slaughter under regulatory controls.
- Inspection of swine entering markets that returned to farms.
- Maintenance of records of origin and disposition by dealers in swine.

Phase III—Elimination of Outbreaks

- Elimination of infected herds in their entirety with payment of indemnities from State and Federal agencies as necessary to accomplish that purpose.
- Operational plans for handling disposal of infected and exposed swine; inspection of swine in infected areas and those exposed in market channels.
- Arrangements for cleaning and disinfection of infected premises and swine-handling facilities.

Phase IV—Protection Against Reinfestation

- Active operation of a reporting and search program for 1 year, with no hog cholera

diagnosed in the State.

- No vaccination with live virus hog cholera vaccines, with all vaccination with inactivated vaccines to be reported to the State.
- Swine imported for feeding and breeding purposes to be subject to 21-day isolation after arrival unless originating in another "hog cholera free" State.

Any State that progressed through all four phases could be declared "hog cholera free." As it was recognized that it would be impossible for a single State, in spite of all precautions, to remove any possibility of exposure from outside, free States would retain that status if a single (primary) outbreak occurred that was promptly and completely eliminated with no further spread.

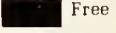
Following adoption of this defined, multilevel program, and with Federal funds available for cooperative effort, States moved rapidly. By the end of 1964, 49 States—all but Texas—had entered the program; 25 of these had advanced to Phase II and 10 had gone further into Phase III or beyond. (Fig. 3-3.) On September 24, 1964, Vermont—where hog cholera had not been reported since 1961—became the first "hog cholera free" State.

National Goals Established

While the four-phase structure provided a way for each State to decide the pace appropriate to its situation, no time schedule for the national effort was defined. USDA officials had expressed the hope

January 1, 1965

Control Phases

 I Preparation  III Eliminating Outbreaks  Free

 II Reducing Incidence

 IV Protecting Against Reinfection

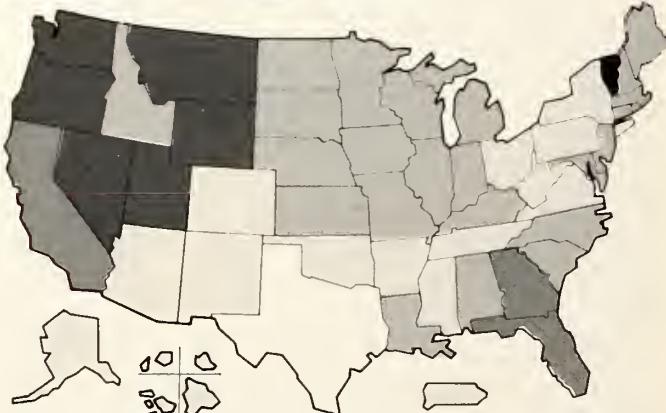


Figure 3-3.—Status of the cooperative State-Federal eradication program, January 1, 1965.

during Congressional hearings on the 1961 legislation that the program would be concluded in 10 years, but no national goal for completion had been established when the actual program started in 1962.

In early 1964, the National Hog Cholera Committee of Livestock Conservation Incorporated (LCI), recognizing the stimulus that would result from established targets for completion, drafted a set of goals for hog cholera eradication. These were deliberately optimistic. They presumed sufficient funding and timely adoption and enforcement by all parties of all necessary requirements. Given these assumptions, however, the goals were believed to be attainable. They were as follows:

End of 1964—all States in the program.

End of 1967—all States in Phase III or IV.

End of 1969—"practical" eradication of hog cholera.

End of 1972—declaration of the country as "hog cholera free."

During 1964 these goals were reviewed and adopted by the USDA and USAHA hog cholera committees.

The time schedule provided 3 years, from 1969 to 1972, for searching out remaining vestiges of the

disease. It was hoped—in 1964—that by 1970 hog cholera would be hard to find.

Experience differed from expectation. Hog cholera was not hard to find by the end of 1969 or even by the end of 1972. In actuality, 1969 proved to be the year with the highest number of confirmed cases (1,481) during the entire program. And an upsurge of outbreaks in the late summer and fall of 1972 led to declaration of a national emergency for hog cholera in October of that year. Instead of concluding at the end of 1972, the campaign was not completed until the end of 1977. (Fig. 3-4.)

This delay was due to delays in meeting the conditions on which the goals were based. Funds—both State and Federal—were not always available in the amounts needed to keep the program moving at maximum speed. Complacency crept in at several stages of the effort and the stringent measures needed to finish quickly were not always carried out.

But the national goals set up in 1964 were a valuable set of targets for those concerned with the program. They provided guide posts against which to measure national progress and stimulated efforts to correct conditions causing delay in meeting the targets. (Fig. 3-5, 6.)



Figure 3-4.—Confirmed cases of hog cholera, 1964-77.

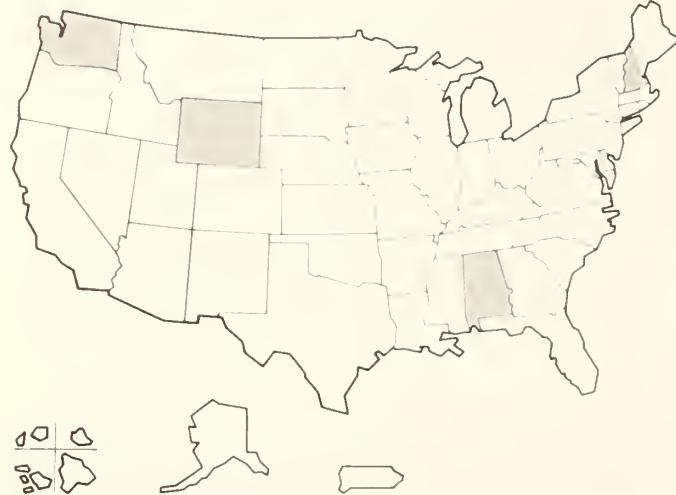
Figure 3-5.

**Cooperative State-Federal
Hog Cholera Eradication Program
1963-78**

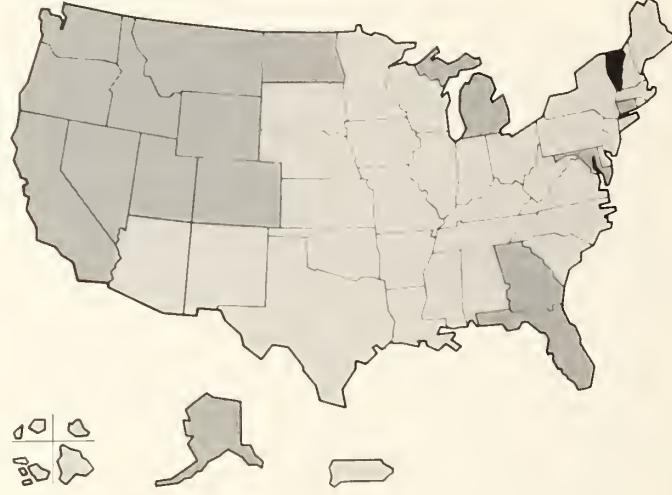
Phases

- No Program
- Control (I. preparing; II. reducing incidence)
- ▨ Eradication (III. eliminating outbreaks;
IV. protecting against reinfection)
- Free

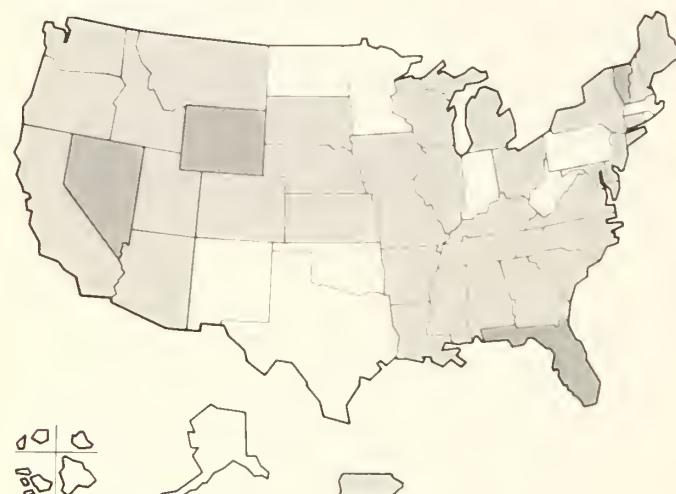
January 1, 1963



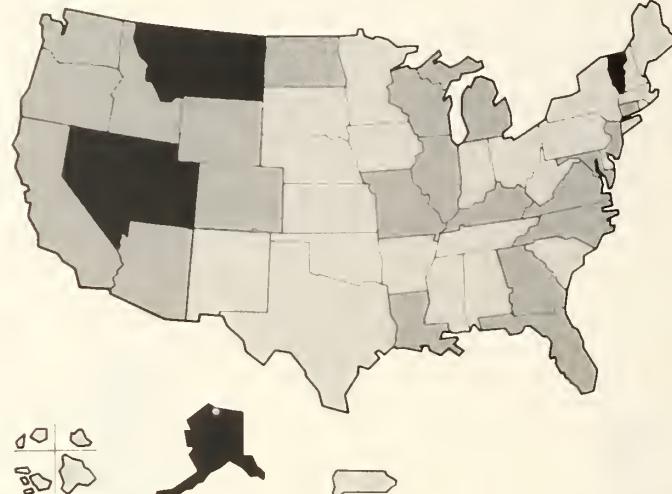
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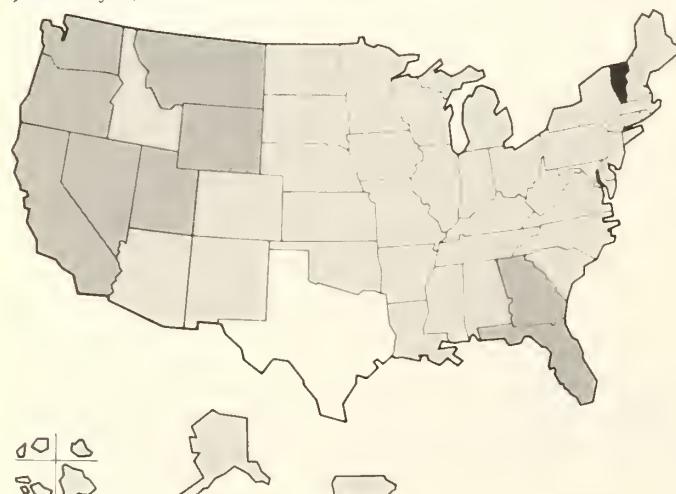
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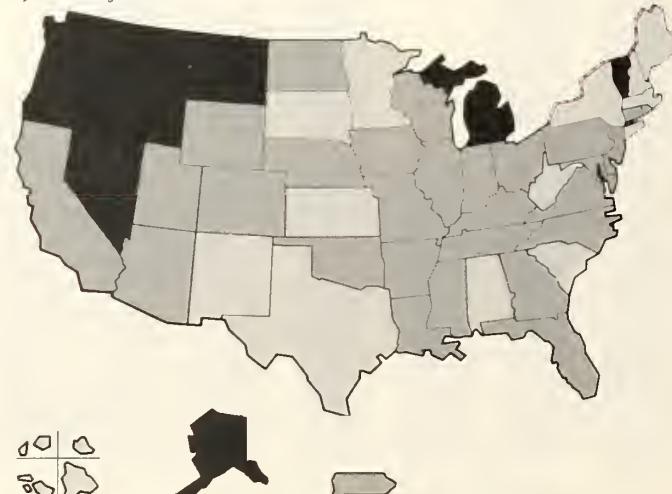
January 1, 1967



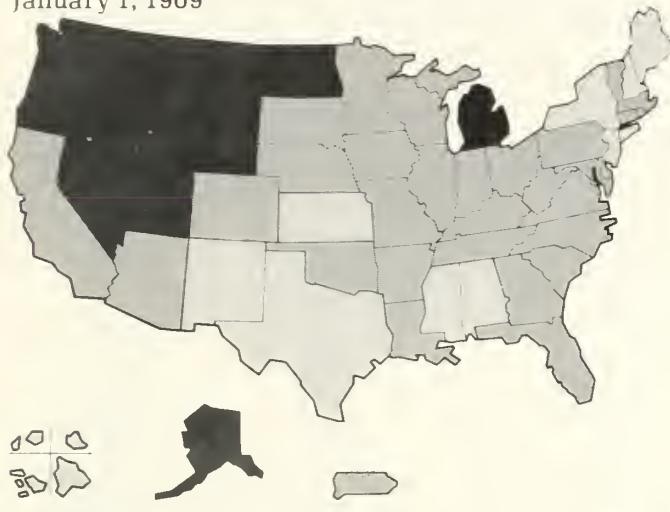
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January 1, 1968



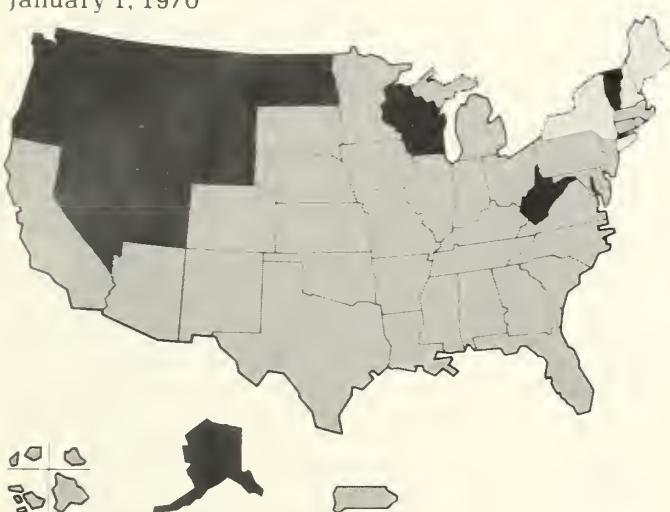
January 1, 1969



January 1, 1972



January 1, 1970



January 1, 1973



January 1, 1971



January 1, 1974



Continued on next page

Hog Cholera Eradication Program, 1964-77

January 1, 1975



USA Hog Cholera Free
January 31, 1978*

	Date of last case	Date live vaccine stopped
Alabama	12/70	4/68
Alaska	—	2/65
Arizona	2/70	8/68
Arkansas	3/71	1/68
California	8/69	7/69
Colorado	5/64	7/70
Connecticut	10/70	7/69
Delaware	6/70	7/70
Florida	7/72	4/67
Georgia	11/72	2/67
Hawaii	5/67	1/70
Idaho	6/57	2/66
Illinois	6/71	7/69
Indiana	6/73	10/69
Iowa	3/70	7/69
Kansas	9/72	7/69
Kentucky	9/72	1/68
Louisiana	8/72	1/68
Maine	4/65	7/68
Maryland	12/72	7/68
Massachusetts	7/76	3/77
Michigan	5/71	4/66
Minnesota	3/71	6/69
Mississippi	2/74	1/68
Missouri	3/71	3/68
Montana	8/64	2/65
Nebraska	8/72	1/67
Nevada	2/69	11/64
New Hampshire	4/76	6/77
New Jersey	8/76	7/70
New Mexico	1/71	6/69
New York	10/69	6/67
North Carolina	1/73	4/69
North Dakota	10/68	9/67
Ohio	11/72	11/68
Oklahoma	5/71	11/67
Oregon	10/68	8/66
Pennsylvania	1/73	1/68
Rhode Island	2/76	—
South Carolina	11/72	1/69
South Dakota	7/69	7/67
Tennessee	11/72	7/67
Texas	7/75	11/71
Utah	11/68	11/64
Vermont	1/68	9/63
Virginia	2/73	7/68
Washington	1/68	8/66
West Virginia	4/70	7/68
Wisconsin	6/67	1/68
Wyoming	6/67	7/67
Puerto Rico	5/74	3/69
<hr/>		Confirmed cases
<hr/>		Suspicious cases

Figure 3-6.—Reported cases of hog cholera, by State, 1964-77.

*Phase designation eliminated November 18, 1975

Confirmed cases during calendar year¹

1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
60	25	3	25	13	4	14	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	—	—	4	1	1	1	—	—	—	—	—	—	—
11	2	3	7	3	93	6	1	—	—	—	—	—	—
7	4	—	1	1	2	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	1	2	—	—	—	—	—	—	—
—	1	—	—	—	6	1	—	—	—	—	—	—	—
—	2	—	1	67	25	—	4	2	—	—	—	—	—
175	286	26	33	200	30	7	—	6	—	—	—	—	—
1	—	—	1	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
90	60	46	33	16	56	33	1	—	—	—	—	—	—
88	33	23	26	8	32	11	3	43	2	—	—	—	—
185	65	57	59	21	22	1	—	—	—	—	—	—	—
22	12	12	26	11	8	4	—	2	—	—	—	—	—
20	25	8	9	23	19	—	—	12	—	—	—	—	—
9	3	9	12	4	46	7	1	2	—	—	—	—	—
1	1	—	—	—	—	—	—	—	—	—	—	—	—
8	2	5	2	—	78	11	—	2	—	—	—	—	—
4	1	—	1	1	12	18	3	—	1	—	—	6	—
11	3	—	3	1	4	—	1	—	—	—	—	—	—
31	18	38	46	22	9	4	3	—	—	—	—	—	—
11	30	12	13	25	51	60	1	1	—	1	—	—	—
114	36	37	69	47	218	64	1	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—
31	35	44	84	30	25	2	—	3	—	—	—	—	—
—	—	—	—	—	1	—	—	—	—	—	—	—	—
—	—	—	4	—	—	3	—	—	—	—	—	—	1
4	3	3	13	3	1	5	2	16	1	—	—	10	—
1	—	—	1	—	—	1	1	—	—	—	—	—	—
3	3	2	1	3	1	—	—	—	—	—	—	—	—
76	90	77	160	71	208	140	24	33	2	—	—	—	—
—	—	7	14	1	—	—	—	—	—	—	—	—	—
32	18	7	19	26	29	34	4	18	—	—	—	—	—
1	—	17	14	2	48	10	1	—	—	—	—	—	—
—	—	—	—	6	—	—	—	—	—	—	—	—	—
2	8	3	3	3	4	3	1	3	1	—	—	—	—
2	—	—	—	—	4	5	1	—	—	—	—	—	1
39	45	11	38	29	110	15	—	6	—	—	—	—	—
35	12	21	38	3	7	—	—	—	—	—	—	—	—
12	20	20	34	52	24	3	1	9	—	—	—	—	—
1	8	10	20	61	213	87	55	43	1	—	2	—	—
—	—	—	4	1	—	—	—	—	—	—	—	—	—
6	18	12	12	44	64	116	3	—	6	—	—	—	—
—	—	—	—	2	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	1	—	—	—	—	—	—	—
4	—	4	2	—	—	—	—	—	—	—	—	—	—
—	—	2	1	—	—	—	—	—	—	—	—	—	—
6	12	15	19	20	25	10	6	4	2	4	—	—	—
1,117	881	534	854	822	1,481	679	118	205	16	5	2	18	—
1,664	1,701	1,499	3,143	4,533	6,484	5,716	3,878	5,025	2,142	1,338	822	2,368	778

¹Each infected herd represents one case. The reporting system began in 1963, but was not fully operational until 1964.

Incomplete figures.

The National Committees

By early 1962, with the creation of the USDA Advisory Committee on Hog Cholera Eradication, as specified in the 1961 Act, there were three nationally oriented hog cholera eradication committees. The USAHA committee had been active since 1950 and the LCI committee since 1958. Both had assumed responsibilities essential to formulation and initiation of a national effort.

The USAHA group provided a forum for reporting and review of the many advances in products and procedures for immunizing swine against hog cholera that took place during the 1950's. As committee membership came from many backgrounds, including State and Federal Governments, the give and take necessary in formulating annual committee reports resulted in recommendations for action that were generally supported by all.

The LCI committee and the member organizations represented could and did work in areas largely closed to the public service officials in USAHA. LCI and its supporting groups led the campaign for legislative action to support an eradication program. The first report of the LCI committee in 1958 also included in its recommendations enactment of Federal and State laws to outlaw use of virulent hog cholera virus—an action also supported in 1958 by the National Association of State Departments of Agriculture (NASDA). As LCI spoke for swine producers and industries dependent on swine production, the support of LCI for an eradication program and the measures needed to carry it out carried weight with legislative bodies.

To the USAHA and LCI groups was added the newly created USDA Advisory Committee. The membership of the USDA committee was required by law to come from many interest areas. The original 12 members included a swine producer, producers of veterinary biologics, livestock market people, the meat industry, the news media, a national farm group, organized veterinary medicine, and State and Federal Governments.

The USDA committee quickly took a step that resulted in cooperation rather than competition between the three national groups. In April 1962, it decided to invite the USAHA and LCI groups to meet in joint session in the following month to plan implementation of the national program.

In May, the first joint meeting was held in Chicago. Thirty members of the USDA, USAHA, and LCI committees were present. Their discussions ranged over many program interest areas, including a phased approach to a national program, hog

cholera vaccination, regulation of swine movement, future handling of indemnity payments, and the need for a strong information effort. It was agreed that all were dedicated to an eradication effort rather than a control program short of eradication.

The May meeting set a pattern for joint sessions that was followed throughout the program and was of great significance to final success. Due to the continuing interchange of problems and possible solutions during these meetings, neither competition for recognition nor duplication of effort developed between the committees.

Although consulting together, each group tended to concentrate on particular program needs. The USAHA worked with program procedures and technical and scientific questions. The LCI stressed State-level industry organizations, sought improved public understanding, and pushed the governmental agencies to keep the program moving ahead. The USDA committee monitored the Department's activities, kept informed of activities of USAHA and LCI, and made recommendations to the Secretary of Agriculture on needed USDA actions.

Subchapter A—Phase I

The Years of Preparation (1961-66)

Scientific and Technical Developments

Agreement on what needed to be done to eradicate hog cholera—as outlined in the four-phase program—was not the same as knowing or agreeing on how this was to be carried out. While the usual differences of opinion on timing and emphasis common to public programs were to be expected, there were basic technical and scientific matters regarding hog cholera that had not been directly addressed previously in terms applicable to an eradication program.

A basic policy question facing any animal disease eradication program is one of defining a diagnostic procedure. This was a particularly thorny issue for hog cholera. Over many generations, veterinary practitioners, veterinary research scientists, and swine producers had developed individual concepts on diagnosis of the disease based on their particular needs. In the case of the producer and his veterinarian, the need was for a quick decision on which to base handling of the disease problem in the herd. A definitive answer was not as important as was a quick decision to initiate action against suspected hog cholera rather than some other less dangerous condition with similar early symptoms.

For the person in research, accuracy was essential. This tended to carry over into the diagnostic laboratories, many of which were connected to institutions doing research. These people felt a responsibility to be as certain as possible before reaching a decision. In 1961, this level of certainty was believed by many scientists to require inoculation of test swine with material from the suspect herd. This delayed a definitive diagnosis for up to 30 days—too long for an eradication effort against an acute, rapidly moving disease such as hog cholera.

To be valid for such a program, the diagnostic procedure must combine many features:

- It must be sufficiently specific to be scientifically and legally supportable—as those with the burden of making a diagnostic decision that results in compulsory slaughter of an entire herd must know they will not be held personally liable in the event of a difference of opinion.
- It must be practical—not requiring an array of instrumentation so complex as to be generally unavailable.
- It must be rapid—as the key to attacking a virus such as hog cholera is early diagnosis so that further spread of infection can be prevented.

A diagnostic procedure was needed that would satisfy these conditions. Program diagnosticians could not depend on personal opinion on what hog

cholera should look like. Lack of consistency between individuals would lead to endless argument between diagnosticians and owners and their veterinarians that would destroy confidence in the program. There was no single, rapid, and specific test for hog cholera. A standardized field diagnostic procedure was needed as part of the steps to be taken in Phase I and continued through the program.

Diagnosis of hog cholera on the basis of clinical observation had come to be regarded as an art as well as a science, as illustrated by the words of S. H. McNutt of the University of Wisconsin, speaking to a symposium on hog cholera in Minneapolis in 1961: "... the only typical thing about hog cholera is that it is always atypical. In the diagnosis of hog cholera one employs common sense, the least common of the senses . . ."

USDA staff veterinarians, in reviewing pertinent literature and discussing diagnosis with experienced clinicians, realized that while no single set of procedures had been agreed upon, there appeared to be common agreement on many items significant to an accurate diagnosis. Replies to a 1961 survey of laboratories listed as having hog cholera diagnostic capabilities showed that 86 percent felt their procedure was acceptable without lengthy swine inoculation procedures.

In October 1962, the Conference of Veterinary Laboratory Diagnosticians—meeting in Washington concurrently with the USAHA—was asked by the USAHA committee to convene a group of scientists to develop a diagnostic procedure that could be used as a standard in the hog cholera eradication program.

Recognizing the urgency of the need, this group, in less than a week, developed a systematic procedure containing factors known to be important in arriving at a diagnosis.

These factors, which were assigned points on a weighted basis according to relative diagnostic importance, included herd history items, clinical signs, pathological lesions, and laboratory tests then known such as evidence of low white blood cell count and the presence of microscopic lesions in the blood vessels in the brain. At least one laboratory-type test was required to complete a positive finding. This could be met by a white blood cell count which could be carried out on the farm by a veterinary diagnostician equipped with a microscope. The procedure was proposed as a guide for diagnosis, leaving the professional judgment of the veterinary diagnostician as the final determinant.

This procedure was subsequently compared with

all suspect cases over a 6-month period. It was found that application of the factors resulted in agreement with the investigating veterinarian's diagnosis in 95 percent of the cases. The procedure was adopted, after final review, as a standard for use in the program.

This standard diagnostic procedure, modified as additional knowledge became available, was used throughout the field program. It was never seriously questioned—a credit to the small group of qualified people who developed the original outline. It filled an urgent need at the right time and disposed of what could have been a major obstacle to a united program effort.

The diagnostic procedure was greatly strengthened by 1965 with the addition of a rapid and specific laboratory support test—the fluorescent antibody procedure—with a weight equivalent to swine inoculation.

This laboratory method had earlier been applied to other diseases. In general terms, it involves using a fluorescein dye to label specific antibodies produced by the body in reaction to infection with a specific virus. These labeled (dyed) antibodies, when attracted in quantity to a virus particle in the usual antigen-antibody reaction, can then be observed microscopically in a "clumping" pattern that can usually be differentiated from material not containing the virus.

In the early 1960's, work done at the University of Nebraska determined that this procedure might be applicable to the diagnosis of hog cholera.

Scientists at the USDA's National Animal Disease Center—representing both veterinary research and laboratory diagnostic activities—further studied and refined the techniques, including means for practical application to the field program.

Tissue from a hog suspected of having hog cholera could be examined within hours after the sample reached the laboratory. In the hands of experienced people, the efficacy of the test was high—about 90 percent. Tonsil tissue, found to be a prime location for early detection of virus, could be obtained quickly in the field from the living animal.

These factors combined to promote rapid and widespread use of the test once it was approved by USDA for use in the hog cholera program. Later refinements of the test made it possible to locate obscure cases of the disease that might otherwise have gone undetected. (Fig. 3-7, 8, 9).

Diagnostic Training

At the beginning of the program, there were few veterinarians in government field service who had



Figure 3-7.—Tonsil tissue, a prime location for early detection of hog cholera virus, could be obtained quickly in the field from a living animal. It could then be tested within hours after the sample reached the laboratory.



Figure 3-8.—Development of a rapid and accurate laboratory test—the fluorescent antibody procedure—in the mid-1960's was a great aid to the eradication program. The fluorescent antibody tissue section technique—shown above—helped speed diagnosis of hog cholera.

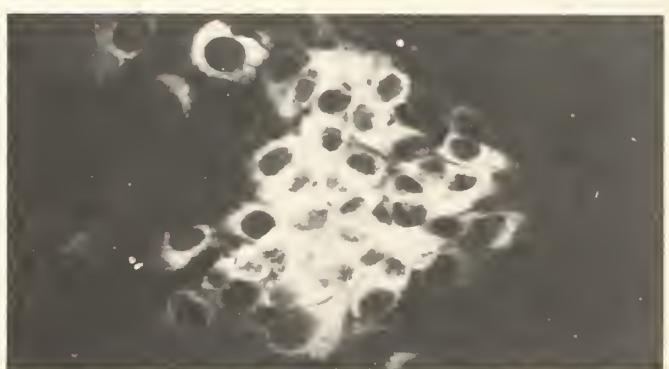


Figure 3-9.—A "bright stained look" characterizes cells that have been taken from an infected hog and which have been treated with fluorescent dye used in combination with anti-hog cholera serum. Infected cells retain the dye-serum and are readily distinguished from noninfected cells.

extensive experience with hog cholera; yet Federal and State field veterinarians were going to have to make decisions on diagnosis. In the spring of 1961, when it appeared that national legislation might soon be enacted that would initiate an eradication effort, it was decided within the Animal Health Division of USDA to follow the example earlier set in training diagnosticians for vesicular diseases of livestock. This involved an intensive training course for selected field veterinarians who were then equipped and placed on call to answer requests for assistance.

Training of hog cholera diagnosticians started in the summer of 1961, using the just-opened regulatory laboratories of USDA's National Animal Disease Center at Ames, Iowa, and nearby Iowa State University. Over the next 16 years, 25 such courses were held, normally of 2 weeks duration each. During these years, over 400 Federal and State veterinarians received this special diagnostic training.

The initial curriculum reflected areas known in 1961 to be significant in arriving at a diagnosis.

Subject areas included:

- Principles of virology and immunology
- Blood sample studies
- Preparation and shipping of tissues collected in the field
- Lectures and demonstrations on the clinical pattern of hog cholera and gross and microscopic pathology
- Differential diagnosis
- Hog cholera biologics control, including operations in a production plant.

As additional knowledge accumulated, the curriculum was adjusted. In 1963, a lecture on the potential use of the fluorescent antibody technique was added, along with instructions on techniques for field investigations.

By 1965, there was considerable stress on field and laboratory aspects of the less apparent forms of the disease. Discussion of herd depopulation procedures had also been added.

During 1968 and 1969, the chronic forms of hog cholera were receiving specific attention, along with the problem posed by *in utero* transmission of hog cholera in pregnant sows and the possibility of resultant persistent virus infection in newborn pigs. This resulted from the work of an experienced USDA veterinary epidemiologist—a former swine practitioner—who observed that these types of problems were occurring in the field. Other additions included expanded emphasis on field investigations and epidemiology and discussion of virus survival in a host population.

As hog cholera vaccines were being phased out in 1969 and 1970, and reports from the field indicated some unauthorized use of bovine virus diarrhea vaccine in swine, lectures were added on this virus and vaccine in relation to hog cholera diagnosis and epidemiology.

Another significant addition in 1970 was the use of the blood serum neutralization test in the field program. This procedure became important as a tool in judging levels of herd exposure and degree of risk presented.

In 1973, instruction was added in the involvement of insects in hog cholera transmission. Other additions after 1970 were largely devoted to inclusion of additional swine diseases in the differential diagnosis segment of the training. In September of 1977, when the 26th course was held, the title was changed to "Swine Diseases Course for Diagnosticians."

From the beginning in 1961, one of the stated course objectives was to provide participants with the impetus and fundamentals for post-course continuing education. As an aid to previously trained diagnosticians, a series of week-long seminars was held, starting in 1965. Previous subjects were updated and lectures added in new techniques. An important aspect was the opportunity for these experienced field diagnosticians and epidemiologists to exchange information with each other and with the faculty of the course. Eight such seminars were held between 1965 and 1971, including two reserved for State Veterinarians and USDA Veterinarians-in-Charge of State-level field stations. These program administrators needed to be updated on the variety of technical and scientific information being used by their field personnel in carrying out the campaign.

One special diagnostic training session was held in 1972 for veterinarians from other countries. Participants were from Argentina, the Bahamas, Brazil, Chile, Jamaica, Mexico, St. Lucia, Trinidad and Tobago, and Venezuela.

This long series of training courses, largely planned and conducted by the staff of the regulatory laboratories of the National Animal Disease Center, provided a means of direct transmission to the field of the latest information on the disease.

The field veterinarian who became a hog cholera diagnostician returned to his home territory following training. He was equipped with a large traveling case containing the materials he would need in the field. He carried vouchers for obtaining airline tickets and he was expected to respond immediately to a call for assistance when a suspected case was reported.

Scattered across the country, these diagnosticians provided a readily available source of assistance for State and Federal field forces and for veterinary practitioners and swine producers. (Fig. 3-10.) Backed by the resources of the regulatory laboratories at the National Animal Disease Center and an increasing number of State diagnostic laboratories equipped to do fluorescent antibody testing, they could make field decisions quickly at a high level of certainty.

How Much Hog Cholera Existed?

Although hog cholera had been moving about in the United States for more than a century prior to 1961, no certain information existed on the true number of cases each year. While many possible sources of herd infection had been demonstrated in research studies, no factual data were available on the relative importance of the various causes of outbreaks. No good picture existed of what a sick herd should look like, although some experienced research scientists believed that the textbook picture of hog cholera as an acute, highly fatal disease showed only a portion of the total picture.

Prior to an eradication program, it had not been essential to have this type of information. An eradication program, however, could not succeed without it—and the information needed to be factual rather than theoretical. The early years of the eradication program included strong emphasis

on making up these deficiencies.

Reporting

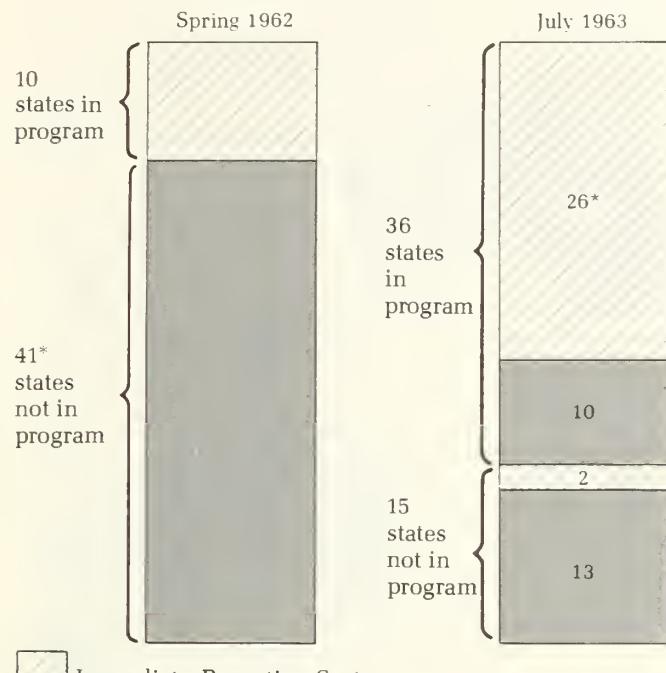
When the program started, about 1.5 million farms in the United States had swine. As there was no practical way to test the some 80 million swine produced annually on these farms, knowledge of where the disease was located would have to depend on the willingness of the swine owner to report suspicious illness. As the presence of hog cholera in a herd was regarded as having a social acceptability equivalent to the more disreputable human diseases, the task was further complicated. The size of the effort is illustrated by the fact that in early 1962 only 10 States had established a system for immediate reporting of suspected hog cholera. (Fig. 3-11.)

An early step in the program was the launching of an extensive educational program on the significance and importance of prompt reporting of suspicious swine illness. The need was stressed by the agricultural press, State hog cholera eradication committees, the Agricultural Extension Service and by the regulatory agencies through radio and television spots and information mailings.

By July 1963, 28 States had established immediate reporting systems. At the end of 1965, such systems were operating in 47 States containing 97 percent of the swine population. This does not mean that all cases were yet being reported in 1965—in that year



Figure 3-10.—Field veterinarians trained in hog cholera diagnosis followed up on "sick calls" to check suspected cases of hog cholera.



Immediate Reporting Systems

*Includes Puerto Rico

Figure 3-11.—Establishment of immediate reporting systems in the States was a high priority in the early years of the eradication program.

only 1,701 suspicious reports were received—but for the first time hog cholera was established in most of the country as a disease requiring prompt notification of animal health authorities.

Sources and Spread

To be effective, disease eradication policies and actions must be based on accurate knowledge of sources of infection and possible spread of the disease from infected herds. (Fig. 3-12.)

In July 1963, following adoption of a standardized format for detailed investigation of suspect cases, data began to accumulate on the history of each known infected herd. Investigators assigned an apparent source of the infection if the evidence was sufficient to do so. At the end of the first year, apparent sources were assigned for only 50 percent of the confirmed cases studied. The leading source was addition of infected or exposed swine, with most of these coming from within the State. Neighborhood infection was next in importance, and infection associated with vaccination was third.

By the end of 1966, investigators were able to assign sources to 78 percent of the confirmed cases. Results showed that additions to the herd and neighborhood exposure remained as prime threats—

although the percentage of infection from herd additions had lessened following 3 years of regulatory efforts to control swine movements. The big change from 1964 through 1966 was infection associated with vaccination. These cases rose from less than 10 percent of the cases assigned a source in 1963 to almost 30 percent in 1966. (Fig. 3-13.)

Another regulatory deficiency showed up in these investigation results—infestation from feeding uncooked garbage rose from 3 percent of the confirmed cases in 1964 to 7 percent in 1966.

The investigation reports confirmed some prior beliefs and identified future problems. The studies confirmed that swine-to-swine contact was the biggest source of infection. Administration of regulations controlling swine shipment and swine markets would have to be improved, as would the effectiveness of herd quarantines. The known risk of feeding uncooked garbage to swine would have to be reduced by stronger enforcement of existing State and Federal requirements.

By the end of 1966, field investigation results had also identified the most controversial issue the program would face in the next few years—that of risk of infection from hog cholera vaccines. In the early years of the program, it was important to keep the vaccination level high in order to assist in blocking spread of infection. By the mid-60's, however, it was becoming evident that the capability of the modified virus vaccines to occasionally spread infection meant that these vaccines could not be allowed in the final stages of the program.

In identifying sources of infection, it was important to study all the swine illnesses suspected of being hog cholera, not just those that were most evident. Eradication depended on finding all cases—not just the most dramatic or damaging ones. For any disease requiring reporting by owners to find infection, a comparison of total suspicious reports with those finally confirmed as infected is significant in deciding if the less obvious cases are being reported. The greater this ratio, the greater the confidence that all the infection is being found.

At the beginning of the program, veterinarians of USDA's Animal Health Division concluded that until at least 10 suspicious reports were investigated for every case finally confirmed as hog cholera there could be no real confidence that field coverage was adequate. In 1964, the first full year of field investigations, 67 percent of the suspicious reports were confirmed as hog cholera. This meant that many cases were being missed. The confirmation rate had dropped by 1966, with only 36 percent of suspicious reports confirmed that

How Hog Cholera
Can Spread

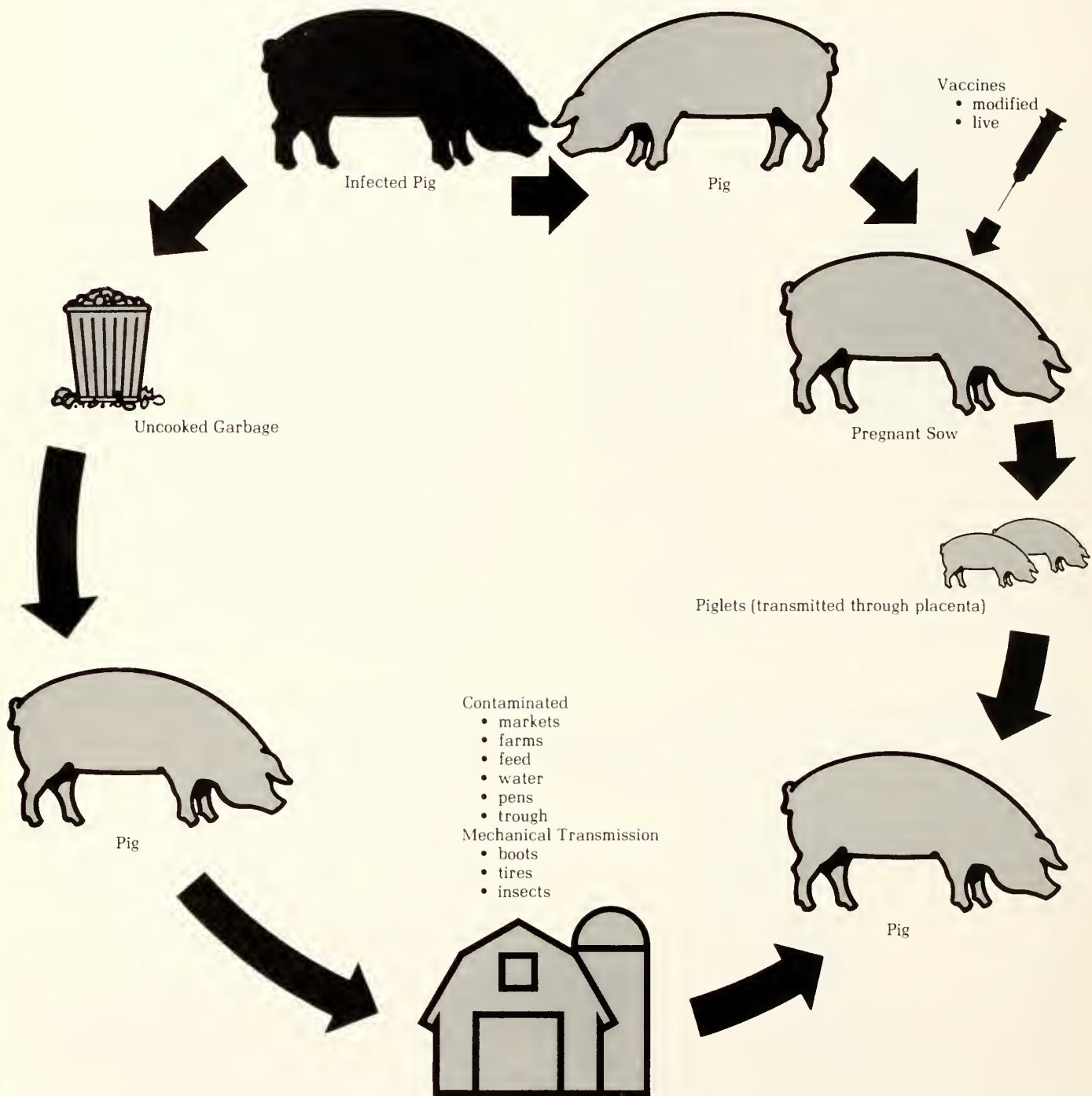


Figure 3-12.—This diagram illustrates the various sources of hog cholera and how the disease can spread.

year—but this was still too high.

By 1970, the confirmation rate was 12 percent, and by 1973 it had dropped below 1 percent. In 1977—the last year of the program—778 suspicious reports were received and investigated; none were confirmed as hog cholera. (Fig. 3-14.)

Changing Perceptions

While it was known for many years prior to 1960 that hog cholera could cause chronic as well as acute illness in swine, the cases that got the most attention were acute attacks that rapidly spread in the herd and killed a high percentage of the infected animals within 3 weeks of exposure. Even in the chronic forms of the disease, few affected pigs were expected to survive—although cases were known in which deaths of chronically ill swine were delayed as long as 95 days.

Chronic cases could be found, however, if the reporting of swine illness increased to cover more obscure types of symptoms and as field diagnosticians gained experience. Even more threatening to the eradication program would be the presence of carrier pigs—animals harboring and shedding the virus without themselves showing much evidence of illness.

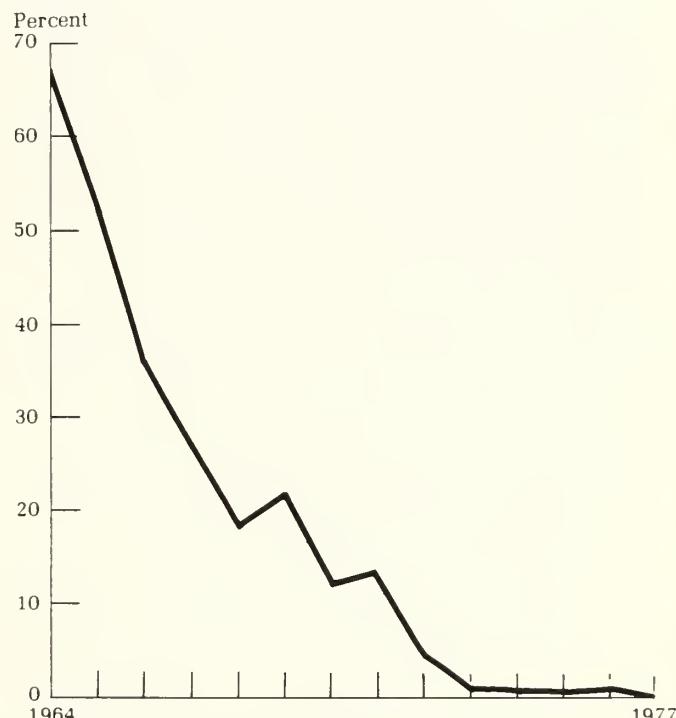


Figure 3-14.—The hog cholera confirmation rate—number of suspicious reports compared with cases actually confirmed—provided a good indication of progress toward eradication.

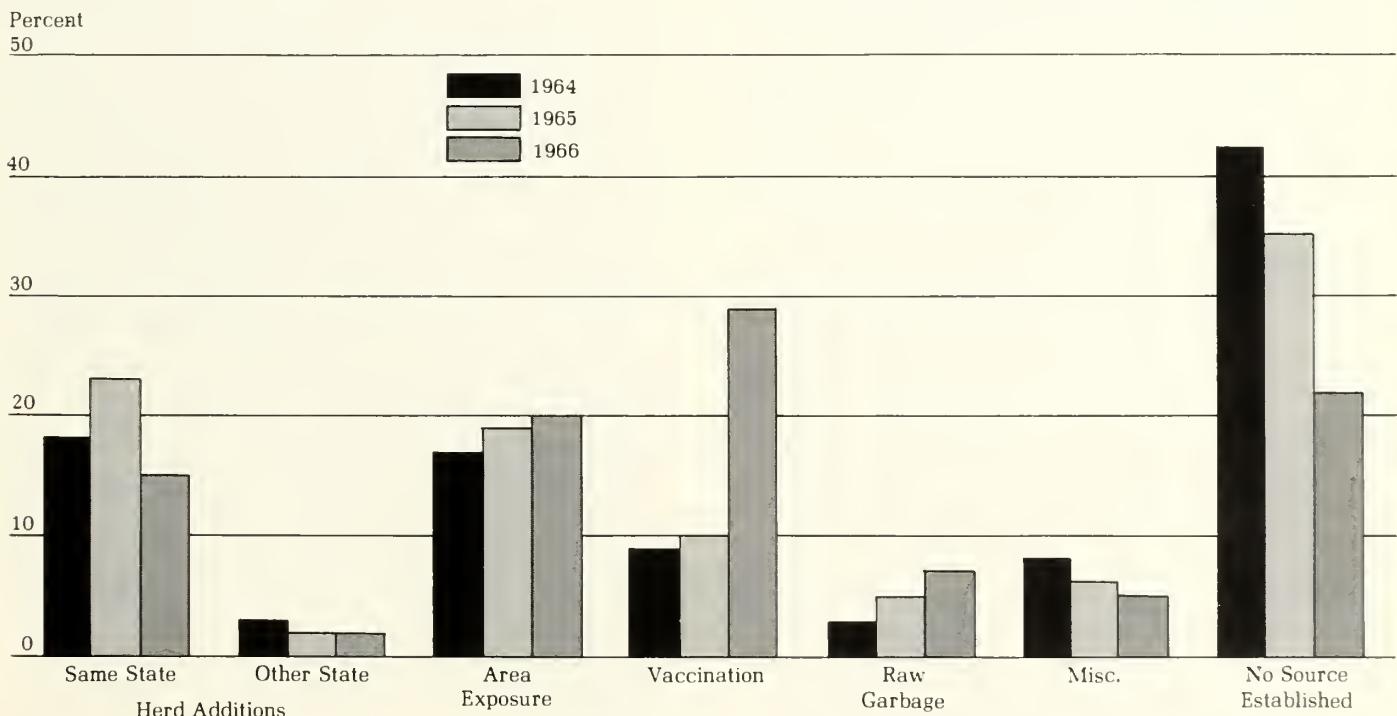


Figure 3-13.—Outbreaks of hog cholera attributed to vaccination accounted for a big shift in sources of outbreaks from 1964 to 1966.

While this risk was little discussed in the United States as the eradication program was being initiated, papers had earlier been published referring to this possibility. C. F. Lynch, in 1914, published studies done in the United States that he believed showed a carrier status in swine that had recovered from hog cholera. In 1933, C. S. Gibbs published work done in China that led him to a similar conclusion.

Records on case investigations that started accumulating in 1963 soon showed that a perception of hog cholera in the United States as an acute, highly fatal disease was not truly representative of the real situation. By 1965, field diagnosticians were frequently finding outbreaks with a clinical picture that was obscure—cases that probably would not have been diagnosed as hog cholera without the assistance of laboratory tests.

This situation was not unique to the United States. Canada experienced a widespread outbreak in Quebec in 1960-61 in which 57,000 hogs were destroyed. The source was believed to be pork shipped in from the United States. The Quebec cases included many in which the animals showed subacute or chronic symptoms. This caused some early problems in field diagnosis, but the disease was eventually contained and eliminated. "Mild" forms of hog cholera were also observed in such widely scattered areas as Russia, Germany, and Australia. In Great Britain, where an eradication program had started in 1963, it was reported that many cases were in so mild a form that they would not have been recognized prior to the program.

The British also demonstrated that some virus strains of low virulence, when spread to pregnant sows, could be transmitted to unborn litters and result in piglets that lived and shed virus that spread the infection further. These reports, growing out of field cases uncovered during Great Britain's eradication program, confirmed research studies reported from the University of Nebraska in the 1950's and the University of Minnesota in 1961. These studies showed that this type of involvement could arise when pregnant sows were exposed to hog cholera viruses of lower virulence, such as those used in producing modified live virus vaccines.

By 1966, veterinarians of USDA's Animal Health Division had demonstrated, through field investigations and laboratory studies, that transmission of infection through the pregnant sow was occurring in the field in the United States.

By 1966, due to advances in diagnostic techniques and data from investigations of hundreds of field cases, knowledge of hog cholera in the United States

was much more complete than prior to the program. The disease in the field showed widely differing clinical patterns—some requiring laboratory assistance to identify. Virus strains that produced little or no illness in mature animals, particularly the sow, could be transmitted through litters to susceptible swine and produce illness and death. The disease also continued to spread from movement of swine and from contact of infected herds with others in the area. Program policies needed to be adjusted to combat these factors.

An additional concern, expressed during the years an eradication program was being discussed, was the possibility of reservoirs of hog cholera virus in animals other than swine.

This was a legitimate question. Research studies had shown that a number of species could be involved experimentally in carrying the virus to swine. Insects and some birds were capable of mechanically transmitting the disease. It had been shown that the swine lungworm could transmit the disease under laboratory conditions. As the earthworm is involved in the life cycle of the lungworm, this raised the possibility of a naturally occurring lungworm-earthworm-swine cycle. Raccoons had been shown experimentally to be capable of carrying hog cholera virus that would infect swine. While no virus reservoir—other than swine—had been demonstrated under natural conditions, no one could be certain that these experimental situations could not occur in the field.

It was decided that this possibility should not hold up initiation of the eradication effort—an effort directed against the virus in the swine population.

As the program progressed, it was demonstrated that high insect populations in an infected area could promote spread of hog cholera, and insect control eventually became a part of the program when conditions required this action. But no animal species other than swine were identified during the campaign as reservoirs of the virus.

Feral swine (domestic pigs gone wild) did complicate the program in Florida in 1968 and 1969 when many of these animals became infected during a series of outbreaks. A system of surveillance involving trapping, blood testing, and removal of feral swine from locations found infected was eventually successful. Although a large population of feral swine has ranged for generations in the Southeastern and Gulf States, no other significant involvement of this population occurred during the program.

Regulatory Actions

If a troublesome livestock disease could be eliminated by private effort, no large-scale public program would be required.

Therefore, a necessary element in public programs is the exercise of governmental authority to regulate actions that endanger the aim of the effort and that cannot be effectively removed by individual decision. In the United States, with division of regulatory authority between Federal and State Government, close cooperation and coordination is required between these jurisdictions if regulations are to be effective.

Prior to the program, Federal regulation was limited as far as hog cholera was concerned. Interstate movement of diseased livestock was generally prohibited. Federal inspection was maintained at a few large terminal markets, including requirements for the use of hog cholera biologics on swine going back to farms. Swine fed uncooked garbage could not legally be moved interstate except under restrictions—a holdover from the vesicular exanthema program.

There was close Federal regulation of the production of hog cholera biologics. In addition, the producers of hog cholera biologics operated under a marketing order and were subject to Federal regulation of inventories and marketing procedures.

The 1961 Federal legislation mandated action against the interstate movement of virulent hog cholera virus. Also needed promptly was regulation of movement of swine—a necessity confirmed as soon as investigation reports of sources of field outbreaks began to accumulate.

Initial regulatory needs by States were similar—except that many States had already acted to eliminate use of virulent hog cholera virus. Alabama was the first to do so, in 1954. By 1962, 44 States and Puerto Rico had taken this action.

The first Federal regulations adopted because of the program were issued in 1962 and were designed to provide regulatory support for the four phases of the eradication effort. The comprehensive changes required under these regulations took some years to become generally effective in operation. This is particularly true for swine movement controls. The main provisions of the 1962 regulations were as follows:

Interstate movement of virulent hog cholera virus was prohibited except under control for research and biologics production.

Swine exposed to hog cholera could not be moved interstate except under controls set up to reduce risk of disease spread.

Feeding and breeding swine could not be moved interstate from livestock markets or farms without a veterinary health certificate, proper hog cholera vaccination, and individual identification.

During this period, the States were also taking regulatory action along similar lines to control the movement of swine within their borders. In addition, the States were responsible for quarantining herds upon suspicion of hog cholera and maintaining quarantines on those in which hog cholera was confirmed. State authority was also used to require cleaning and disinfection of infected premises.

Increasing Vaccination Levels

The early phases of the program were essentially a disease control effort rather than a full-scale eradication campaign. The aim was to reduce hog cholera incidence to a point low enough to enable imposition of more rigid requirements. Control measures could be most effective in the presence of a high immunity level in the swine population. It was therefore important that the vaccination level be raised in the early program years. At that stage, a high immunity level was the most important consideration. The risks associated with use of vaccines were not then as important to the program as was protection against spread of the disease.

Prior to the eradication program, vaccination against hog cholera was the primary control measure used in the United States. Except in isolated instances, the decision to vaccinate was made by the owner and, with few exceptions, he paid the bill. If there was one thing swine owners understood about protection against hog cholera, it was the significance of vaccination. A market research study commissioned by veterinary biologics producers in 1961 showed that the importance of hog cholera vaccination was recognized by producers, even though they did not—at that time—believe that quarantines were an important control measure.

However, this understanding on the part of swine owners did not result in high levels of vaccination nationwide. In 1959 and 1960, 2 years prior to the organized effort for eradication, only 37 percent of the Nation's pig crop was vaccinated against hog cholera. Cost was the determining factor. In the beginning of the program, such costs were estimated at 20 percent of the net profit from swine production. This economic reality was well understood by swine producers—who had to weigh the cost versus the need for this type of insurance. Most owners decided the insurance was too expensive and took the risk of infection. Others delayed vaccinating

until the disease struck, which was often too late.

Swine owners knew that with vaccination they could live with the disease—and stay in business. However, they were not enthused about facing an indefinite future, for themselves and their heirs, that included this cost. Consequently, the swine industry leaders who worked to get the eradication program started stressed that their aim was to eliminate this continuing expense. The only successful eradication program, from their viewpoint, would be one that eliminated the continuing need for vaccine. There was no quicker way to increase profits.

Yet it was important, for eventual eradication, to start out by raising vaccination levels. This could have been done relatively easily by subsidizing the cost with public funds and this was discussed as the program was being developed. A few States already had some type of publicly supported hog cholera vaccination program.

USDA, however, had already fixed its position on this point. Department representatives had given Congress estimates of total Federal program costs that were only one-fourth of the annual vaccination cost already paid by owners. Federal funds for subsidizing hog cholera vaccination were not contemplated. Other means would have to be used if vaccination levels were to go up.

What took place was a concerted public information effort by industry groups, the agricultural press, and governmental agencies that broadcast information on the need for increased vaccination as a support for the total effort. While no direct cause and effect relationship can be proved, vaccination levels did rise during the early years of the program, when most States were in the early phases of the program and such action was called for.

Hog cholera vaccination rose from 37 percent of the pig crop prior to the program to a high of 52 percent in 1965. In the six States containing over 60 percent of all the U.S. swine (Iowa, Illinois, Indiana, Missouri, Minnesota, and Nebraska), the figure in 1965 rose to 58 percent.

Vaccination levels started to drop in 1966. By that time most States had moved into higher program phases. In addition, field reports had shown a sharp rise in outbreaks attributed to vaccination. While these problems occurred in relatively few of the more than 35 million pigs vaccinated in that year, they did account for 29 percent of the known sources of hog cholera.

Production of hog cholera vaccines, which reached a peak in 1966, fell rapidly thereafter due to decreased demand, until the products were eliminated in 1969.

Principle or Practicality?

A key principle for entry into Phase III of the program (Elimination of Outbreaks) was prompt and total destruction of infected herds. Infected swine shed virus prior to appearance of illness. Such swine, even if apparently healthy when leaving an infected herd, presented the possibility of infecting others through contact in markets or through uncooked pork scraps in garbage. Sound eradication theory required prevention of this possibility in final program stages.

However, by 1965, it was apparent to chief veterinary officials in some Corn Belt States that depopulation of infected herds without salvaging the apparently healthy fat hogs for slaughter purposes would halt their programs due to high indemnity costs—half of which would come from State funds. Even though hog cholera incidence had been sharply reduced in these States, their large swine populations resulted in projected costs for total infected herd depopulation too large to be met by anticipated appropriations.

These State officials came to the USAHA committee to ask about the possibility of altering the requirements on handling of infected herds early in Phase III to allow salvage for meat, with appropriate safeguards, of apparently healthy slaughter-weight swine in the herds. Such swine would not need to be indemnified, as the owner would be selling them for their full meat value.

Such action would appear to compromise a sound disease eradication principle. Yet, if the program was to progress, the Corn Belt States—with most of the Nation's swine—had to continue to advance in the program. The question was how the potential risk compared with potential benefits to the program.

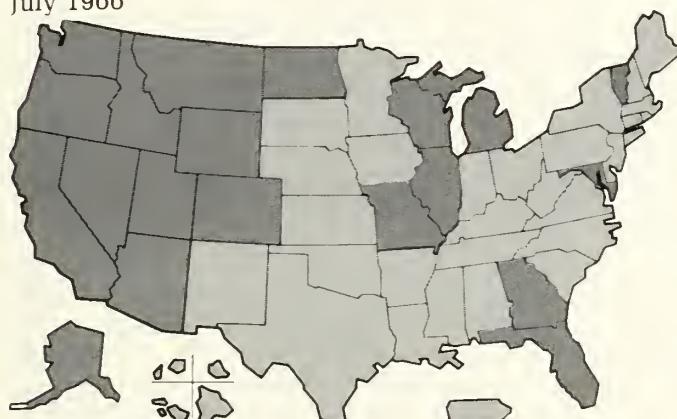
The benefits were obvious. Facts on the level of risk were not defined. Therefore, a study was initiated on tissues taken at slaughter from apparently healthy fat hogs from infected herds in Phase II States.

Results of the study indicated that between 1 and 2 percent of such swine harbored a detectable hog cholera virus. This level of risk would be further reduced by moving such swine under escort directly to slaughter following inspection by a State or Federal veterinarian. Further reduction would result from cooking garbage before feeding to swine

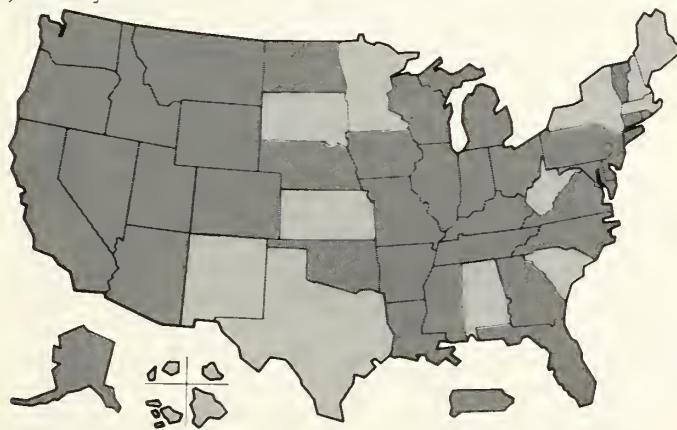
—and these requirements, while not fully effective, were being met by most garbage feeders. No human health risk was involved.

By mid-1966, USDA and USAHA decided that program benefits, at that stage of the effort, outweighed the risks, and changes to the original requirement were adopted on a temporary basis. Use of this modification would be optional on the part of each State, and would not in any event be allowed in States in Phase IV of the program. It was to be discontinued in Phase III States when, or if, it became evident that the benefit/risk balance had shifted so as to damage the program.

July 1966



January 1968



 Control (I and II)
 Eradication (III, IV and Free)

Figure 3-15.—Status of the cooperative State-Federal eradication program, July 1966 and January 1968. Providing for salvage of apparently healthy hogs in infected herds allowed many Corn Belt States with large hog populations to move into the eradication phases (III, IV and Free) of the program during this period.

While this action was not the only factor that allowed Corn Belt States to advance in the program, it did remove the immediate financial roadblock. In the 18 months following the change, the six States with 60 percent of the Nation's swine moved into Phase III—with depopulation of infected herds. (Fig. 3-15.)

Funding in Early Program Years

Funding was not a real problem in the early years of the effort. The Congress and State legislatures were generally receptive to providing appropriations for hog cholera eradication. Total State and Federal funding started at \$1.2 million in 1962 and reached \$5.6 million in 1965—a relatively small amount when compared with the estimated annual hog cholera cost prior to the program of over \$50 million. Costs through FY 1965 were much lower than USDA estimates given to Congress prior to the program, primarily due to the fact that indemnities were not a significant factor in program costs until 1966—later than USDA had originally anticipated.

Indemnities

In most jurisdictions in this country, private property cannot be condemned by public agencies without payment of compensation. Indemnities would have to be paid in Phases III and IV of the program, when infected herds were to be promptly condemned and depopulated whether or not the owner volunteered to do so. An indemnity system needed to be established in preparation for this part of the program.

In the United States, the use of public funds for indemnities in animal disease eradication programs is primarily for public protection. The purpose is to assure quick removal of a dangerous source of infection and not just to compensate owners for loss. Therefore, indemnity procedures include procedures for cleaning and disinfection and other steps in addition to destruction and disposition of animals.

As indemnity costs usually come from both Federal and State sources, there must be agreement on the procedure. While there was no argument on the need for hog cholera indemnities in most States, there was, initially, some discussion on what the eligibility terms should be. This centered on the question of vaccination.

Since a swine producer who vaccinated his herd not only protected his own investment but also furthered the public purpose of the eradication program by helping build an immune population, the

argument was advanced that such a producer deserved special consideration if his herd became infected and had to be destroyed. Some felt that vaccination should be a prerequisite for indemnity payments; others, that a higher rate should be paid for vaccinated swine.

These discussions took place in 1962 and 1963 as part of the development of the Federal indemnity regulation. As the aim of indemnity payments was to further elimination of infection, it was finally concluded that special consideration for vaccination status would interfere with that aim by making owners of nonvaccinated herds reluctant to report illness.

The Federal indemnity regulations, effective in October 1963, permitted Federal indemnities, following appraisal of the herd, for up to 50 percent of the net loss of the value of the swine condemned. Payment was contingent upon following proper disposal and cleaning and disinfection procedures. The balance of the loss was paid from State funds in most States.

As a dead animal has no value for meat or breeding purposes, USDA only appraises live animals under indemnity procedures. To encourage prompt reporting of suspicious illness in swine, a policy was adopted early in the hog cholera program to appraise all swine alive at the time the suspicious herd was first visited—even before the final diagnosis was made. This meant that if the sickness was finally confirmed as hog cholera, those animals that died after appraisal and before herd disposition could still be indemnified. This policy allowed owners to minimize financial loss if they reported illness quickly before deaths multiplied.

Year	Number of herds	Number ¹ of swine	Indemnities paid ²
1965	7	1,354	\$ 30,850
1966	69	21,188	356,814
1967	411	78,356	1,448,170
1968	763	99,310	2,292,848
1969	1,771	267,547	6,500,428
1970	1,280	160,285	5,227,828
1971	577	47,857	1,313,024
1972	633	90,248	3,919,949
1973	76	10,208	716,000
1974	32	449	42,000
1975	31	3,500	350,000
1976	63	24,000	2,900,000
1977	0	0	0
Totals	5,713	804,302	\$25,097,911

¹Includes both infected and exposed swine.

²Includes both state and federal funds.

Figure 3-16.—Indemnities paid for infected and exposed swine destroyed because of hog cholera, 1965-77.

Although Georgia had added indemnities to its program in 1962, using State funds, the first use of State-Federal funds for indemnification in the hog cholera program was in 1965, and covered less than 10 percent of the infected herds found in that year. Most of the Nation's swine in 1965 were in States that had not yet reached Phase III—the program level that required total herd depopulation. Total indemnity costs were rising sharply by 1967, when 75 percent of the Nation's swine were in States that had reached Phase III or Phase IV of the program. (Fig. 3-16.)

Keeping It All Together

For over 10 years prior to the start of the program, those working to bring it about had stressed that obtaining public understanding and support was the key to the effort. This need did not change once the program got started and was recognized by the public and private agencies concerned with the campaign.

From the beginning of the program, at least one USDA information officer worked full time directly with the Animal Health Division of USDA and other groups involved in the program to bring about effective communications. (Fig. 3-17.) The Cooperative Extension Service was active in many States in distributing information on the program. LCI and other agricultural groups did the same, as did the agricultural press. An important function of State-level eradication committees was to keep swine producers informed of what the program was all about and why program requirements were necessary.

The frequent contact between the national-level hog cholera eradication committees regularly brought together members from a variety of backgrounds. These sessions included government officials, vaccine manufacturers, livestock market people, swine producers, meat packers, and several branches of the veterinary profession. The result was that no field of interest was isolated. Major policy proposals were discussed at length before these joint sessions. Final recommendations usually had the support of the various groups, as they had the opportunity to participate in program planning.

Both the USAHA and the LCI hog cholera eradication committees published an annual report. USDA annually published a comprehensive progress report which was supplied to each of these groups. By these means, it was possible for anyone to maintain detailed knowledge of what was happening throughout the country.



Figure 3-17.—Keeping the public informed about progress in hog cholera eradication was an extremely important element of the eradication program.

The Doubters

While the desirability of eradicating hog cholera was not challenged publicly, there was opposition to program procedures as put in operation. Some felt strongly that the task could not be accomplished due to lack of technical information, or difficulties in overcoming past traditions in handling the disease, or lack of support for some of the difficult features of the program.

As late as 1965, USDA regulatory veterinarians were told by their counterparts from some European countries that the United States could not succeed in eradicating hog cholera because long dependence on hog cholera vaccination would make it politically impossible to eliminate these products—and the program would then have to stop short of eradication.

Over the half century prior to the program during which hog cholera immunizing products were used, a large economic interest had built up in their production and use. Some biologics manufacturers could not envision how this important portion of their production could be eliminated as a result of an eradication program. A number of veterinary practitioners devoted much of their time to administration of these products. While neither the biologics industry nor veterinary organizations took a stand opposing the program, it is understandable that some individuals had doubts about a program that could end hog cholera vaccination—particularly as over the long history of the disease in the United States there had been no real evidence of insurance against infection except through vaccination.

Some feeder pig dealers were vocal in their opposition to the elimination of serum and virus, fearing that the "newer" vaccines were not sufficiently effective for their operations. The same was true of a number of garbage feeders and some other swine producers. Some dealers challenged requirements for individual identification of swine in transit as expensive, impractical, and unnecessary.

Many veterinary research scientists had devoted much of their time to studying the disease and knew of the many complex problems that faced an eradication effort. Some did not believe eradication was possible in the United States. Others believed initiation of such a program was premature without additional research.

These concerns were demonstrated in a document sent to the Secretary of Agriculture in November 1963, about a year after the first States had formally entered the cooperative eradication program with USDA. Although some of the scientists

whose names were used in transmitting the report later informed USDA that they disagreed with the report or its method of presentation, the report did voice some of the doubts being heard during that period.

The report included expressions of concern that reservoirs for hog cholera virus—other than swine—might exist, that some swine might be persistent carriers of the virus, and that more accurate means of diagnosing hog cholera in the field were necessary. The report concluded that it might be acceptable to proceed with the program if funds were provided for more research and the program stopped short of establishing hog cholera free areas with elimination of vaccination.

As the questions raised in the report had all been previously recognized as needing study, and as these studies were part of the program effort already underway, USDA concluded that no additional information was presented in the report requiring a change in direction of the program.

There was also some interest during the early program years in finding a way to immunize swine against hog cholera without using hog cholera virus. This centered on the cross reaction between hog cholera virus and bovine virus diarrhea virus noted in Great Britain in the early 1960's.

Tests in the United States by those interested in this possibility showed that swine receiving bovine virus diarrhea virus—a virus already present in U.S. cattle—did develop some protection against hog cholera virus. However, it was also found that this protection was not sufficient to prevent infection with highly virulent strains of hog cholera virus and that swine so vaccinated could in some instances become shedders of hog cholera virus if infected.

For these reasons, plus the fact that a primary aim of the program was to remove vaccination cost no matter what the type of product, this procedure was not accepted as having a place in the eradication program.

Differences also arose over the definition of eradication. USDA had defined hog cholera eradication in 1961 as "elimination from the country so that further outbreaks did not occur unless introduced from outside and so that immunization was not required." This definition was directed toward removing economic loss from outbreaks of the disease or vaccination cost—and not necessarily to searching out any virus strain that was innocuous from an economic standpoint.

Some research people felt this definition was not sufficient and a proposal was made that eradication should not be declared until all traces of antibodies against hog cholera had disappeared from the swine population.

Such a course presumed that antibody testing could be specific for hog cholera virus and that testing surveys in a swine population of over 50 million could be carried out in sufficient volume to give an absolute answer.

There was evidence, based on Australian experience, that reliance on an antibody test not entirely specific for hog cholera could result in a program directed to eradicating antibodies rather than hog cholera virus. The original definition of eradication was retained.

All these questions, raised during early years of the program, caused reexamination of program positions. While some changes in program policy, such as temporary provision for salvage of apparently healthy swine from infected herds, were departures from initial program policy, the basic thrust of the program emerged unchanged.

The program was to be one of disease eradication rather than improved disease control. The program would not compromise with the need to remove vaccination costs as well as to eliminate the disease.

While these policy positions may seem obvious now that hog cholera has been eradicated from the United States, in 1965 they were still regarded by some as risky and radical. However, in large part due to the continuing support of swine industry groups for maintaining the original aims of the program, 46 States and Puerto Rico had moved beyond Phase I of the program by the beginning of 1966.

Subchapter B—Phases II and III

Reducing and Eliminating Outbreaks (1966-70)

The end of 1966 found 26 States—containing one-third of the Nation's swine—in the eradication phases of the program. (Fig. 3-18.) All others, except Texas and Hawaii, were in Phase II. With the majority of the States requiring herd depopulation with indemnities, and most others trying to reduce incidence preparatory to this action, the news from field investigators during that year was disturbing.

January 1, 1967

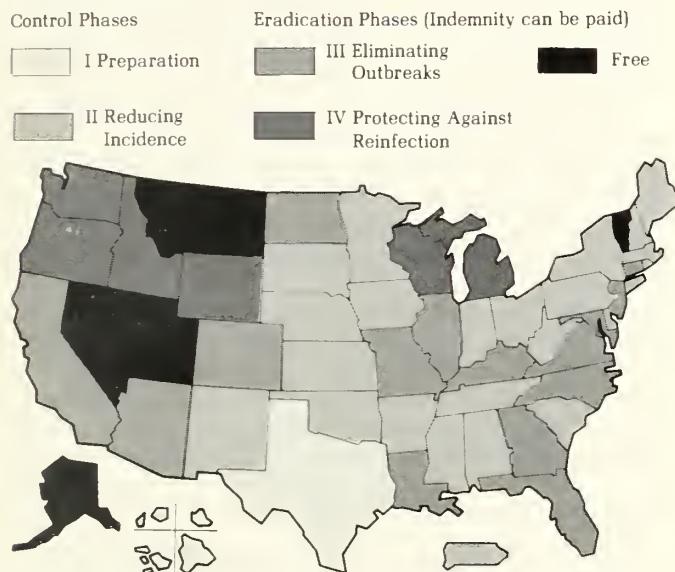


Figure 3-18.—Status of the cooperative State-Federal eradication program, January 1, 1967.

During 1966, investigating veterinarians reported a sharp rise in outbreaks associated with hog cholera vaccination. Such cases rose to 29 percent of all confirmed outbreaks, almost three times the percentage in 1965, and were the largest single source of hog cholera in 1966.

As vaccination levels were beginning to drop during 1966, and as no significant change had taken place in the types of products used, it seems probable that the rapid rise in vaccine-associated outbreaks was largely due to increased ability to gather and analyze information on each outbreak. Success in tracing outbreaks to a specific source doubled in 1966 as compared with 1964.

Vaccine Safety Questioned

In response to these field reports, the USAHA committee called on USDA to exert strong efforts to upgrade safety standards for hog cholera vaccines to keep pace with the reduction of total outbreaks

in the field. USAHA stated that while most problems appeared to arise from misuse of vaccines, there were some vaccines that could cause problems even when properly used.

This was supported by results of a research study started in 1962 by the USDA's Agricultural Research Service in cooperation with the State of Florida. The purpose of the project was to study the spreading characteristics and virulence of the various modified hog cholera virus strains used in vaccine production. By December of 1965, the bulk of the products selected for the study had been tested. Results showed that 77 percent of the vaccines tested caused spread of the vaccine virus—whether or not antiserum was used with the vaccine. The transmitted virus resulted in death of susceptible contact swine for one-third of the vaccines tested. All of the porcine-origin vaccines were shown to be capable of transmitting virus to other swine. The regulatory laboratories of USDA's Veterinary Biologics Division had also identified differing levels of risk between the several types of modified live virus vaccines.

Even prior to the final results of this research work, USDA, in May of 1965, took regulatory action against vaccines of porcine origin by classifying these vaccines as virulent hog cholera viruses. Reasons given were that field and experimental evidence had shown that these products could cause hog cholera both from vaccination and from contact with vaccinated swine.

Additional recommendations for action came from the General Accounting Office—an arm of the Comptroller General of the United States—which sent a draft report to USDA in October 1966 recommending that shipment of modified live virus vaccines be prohibited to States with low hog cholera incidence and that such vaccines, when permitted in any State, be administered only by veterinarians or other designated persons.

The LCI committee, in February 1967, went further. It recommended use of only those vaccines that caused no illness in vaccinated swine and did not result in transmission of vaccine virus to susceptible test animals. LCI, as had the USAHA, also called attention to the danger involved in vaccinating pregnant sows due to the possibility of virus transmission to the unborn pigs.

The Hog Cholera Advisory Committee of USDA, also meeting in February 1967, asked that a study group be established to submit recommendations within 90 days on national guidelines for orderly change from one type of vaccine to another.

The study group met in April 1967. Members came from regulatory and research divisions of USDA.

USAHA, LCI, university research laboratories, and the veterinary biologics industry. As part of its report, the study group asked that the several national hog cholera committees be promptly convened in joint session to consider its recommendations.

In June 1967 the USDA, USAHA, and LCI committees met jointly to consider the recommendations of the study group. The essence of the recommendations was that a timetable be adopted for phasing out all hog cholera vaccines—with modified live virus vaccines to be discontinued by January 1, 1969, and inactivated vaccines by January 1, 1971.

Inclusion of inactivated vaccines in the phaseout schedule was the result of information presented to the study group on difficulties experienced in Nebraska early in 1967. In the 5-month period after elimination of modified live virus vaccines, Nebraska reported 34 hog cholera outbreaks following administration of inactivated vaccines. These largely followed use of specific serial production lots from two manufacturers. Most of the herds involved had received modified live virus vaccine prior to 1967.

While subsequent studies failed to clearly establish the reason for these problems, the potential risk to the goal of eradication was such that the study group recommended that all vaccination cease by the end of 1970.

At the June joint session, the three national advisory committees decided to accept the recommended timetable, making only a few procedural changes. As the Animal Health Division of USDA already supported the timetable, and the States could be expected to support action of the USAHA representatives on the study group, this meant that the State and Federal regulatory groups had decided that hog cholera vaccines now were a greater risk to the program than was the benefit from vaccination.

The Fight Begins

This was not the view of some swine producers and dealers. Their opposition was shared by some veterinary practitioners and research scientists. The adoption of a timetable to phase out hog cholera vaccination crystallized the conflict over vaccination that had been simmering in the background throughout the early years of the program.

The next 2 years were a time of debate on this issue. Although 24 States had prohibited use of modified live virus vaccines by the end of 1968,

USDA was not able to issue the final Federal regulation prohibiting interstate shipment of such products until May 1969, 6 months later than the timetable originally recommended.

The original phaseout plan was modified somewhat later in 1967, after the USAHA pointed out that the schedule should not be linked solely to the calendar, but should also be tied in with the advancement of States to higher levels of program effort. Requirements were also changed for inactivated vaccines to require two doses, 30 days apart, as additional evidence showed that a single dose was less effective.

A further recommendation of the vaccine study group, made when the timetable for vaccine phaseout was presented, was that consideration be given to maintenance of a reserve stockpile of hog cholera antiserum. A few months later, a group representing the American Veterinary Medical Association recommended to the USDA Advisory Committee that stockpiles of vaccines and vaccine seed stock be maintained, along with the antiserum reserve, in case of a "catastrophe" following withdrawal of vaccines from field use. In the next several years, USDA scheduled studies on the cost and administration of such reserves and in fiscal year 1970 requested initial funding for an antiserum reserve. Total funds were short in 1970 due to higher indemnity costs than expected, and the funds planned for the reserve were used for indemnities. An additional request was planned for fiscal year 1971, but program experience by that time, plus increasing demands for indemnity funds, was such that a continuing reserve of antiserum was never actually established as part of the total program.

By February 1968, with continuing vocal opposition to withdrawal of vaccines, LCI decided to sponsor regional meetings to further air the arguments pro and con. Four such sessions were held that spring in several parts of the country. A total of over 250 swine producers and other interested persons attended these meetings, which were sponsored by LCI, the Agricultural Extension Service, and the National Pork Producers Council. The meetings covered not only the question of discontinuing vaccines but also the need to strengthen disease control regulations on movement of swine. At all the regional meetings, following discussion of these issues, resolutions were adopted supporting a cutoff date for vaccine use in the field.

This did not stop the argument. In October of 1968, when the USDA Advisory Committee met in New Orleans in conjunction with the USAHA annual meeting, over 30 outside people came to the USDA session to listen and participate.

USDA officials told those present that proposed regulations were being prepared that would stop interstate movement of modified live virus vaccine and limit use of inactivated vaccines to States still in Phase II of the program, where indemnities were not yet being used. It became evident during the discussion that one of the apprehensions surrounding elimination of vaccines was the ability of State and Federal Governments to pay indemnities should outbreaks increase drastically when vaccine was withdrawn.

On November 20, 1968, USDA published proposed regulations on the withdrawal of hog cholera vaccines, providing 90 days for written public comment. As is usual in comments on proposed regulations, more letters were received from those in opposition than from those in favor. However, this proposal also resulted in some letters accusing USDA of procedural improprieties in developing the proposal. In addition, some members of Congress urged the Secretary of Agriculture to hold public hearings on the proposal. One biologics firm submitted a brief contending that experience in States that had already prohibited live virus vaccines showed that outbreaks had increased and that it was unreasonable to prohibit all such vaccines just because some of them could spread hog cholera.

While USDA concluded that proper procedures had been followed in publishing the proposed regulations, it was decided that the issue was still sufficiently controversial to justify further public discussion. LCI agreed to provide a forum for such a discussion.

All this was taking place in a time when individual swine owners were rapidly discontinuing use of vaccines and 33 States had acted to outlaw live virus products. Eight States had gone further and discontinued use of all vaccines. (Fig. 3-19.) The peak year for vaccine production was 1966, when over 40 million doses were produced. In 1968, production was less than 12 million doses.

USDA regulatory veterinarians remained firm in their belief that the future of the eradication program required phasing out vaccines. They pointed out that while two of the States outlawing live virus products (Georgia and Florida) had subsequently experienced large increases in outbreaks, the remaining States that had taken this action had experienced decreases in outbreak numbers. Further, officials in these two States did not believe their outbreak increases were due to vaccine withdrawal, but to other factors such as herd additions.

Neither State acted to rescind their action

removing vaccines. USDA staff veterinarians also remained convinced that while there were gradations of risk among the vaccines, field experience demonstrated that all had some degree of danger.

In February 1969, the LCI session in Sioux City, Iowa, attracted over 200 people. Arguments against withdrawing vaccines were again heard. But most of those present supported publication of final USDA regulations, and there were criticisms of USDA for delay in requiring withdrawal of vaccines. Following the discussion, the LCI Committee stated that USDA should:

- Finalize Federal regulations on vaccine withdrawal, combined with efforts—which LCI promised to support—to provide sufficient indemnity funds.
- Continue studies on developing a standby biologics reserve.
- Urge States to move into advanced stages of the program requiring prompt elimination of infected herds.
- Discontinue salvage of hogs from infected herds.

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individual types of products as evidence concerning undue risk became available.

By 1965, the Veterinary Biologics Division of USDA had developed methods to determine the true susceptibility to hog cholera of pigs used for testing vaccines. It was then possible to screen licensed vaccines not only for the ability to protect against the disease, but also for the relative ability to spread hog cholera.

In 1966, USDA started a program of removal of vaccine types found in testing to be unduly dangerous. In 1967, Federal regulations started listing, by brand name or description, those vaccines approved by USDA for use under the program. Vaccines not listed were automatically classified as too dangerous for unrestricted interstate shipment.

During the period of argument over vaccine withdrawal, vaccine-associated outbreaks dropped from a high of 31 percent in 1967 to 9 percent in 1968 and to only 1 percent in 1969. (Fig. 3-20.)

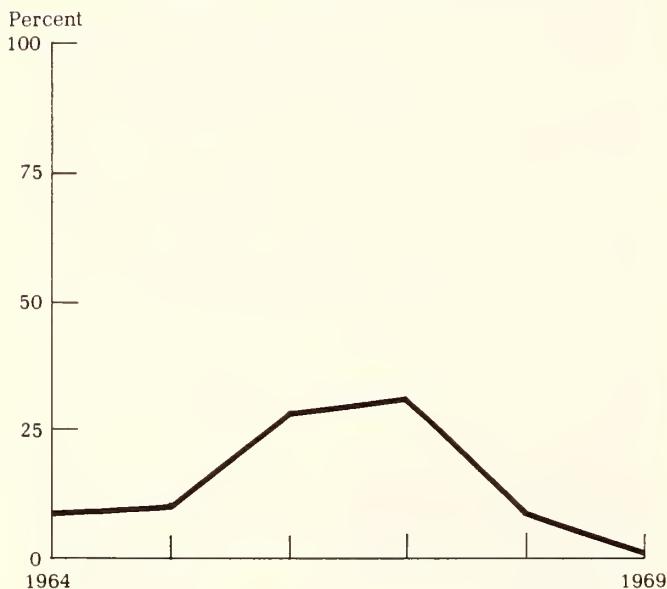


Figure 3-20.—Vaccine-associated outbreaks dropped from a high of about 31 percent in 1967 to only 1 percent in 1969.

The Turning Point

On May 24, 1969, USDA published final regulations that prohibited the interstate movement of modified live virus hog cholera vaccines after July 1 of that year. The same regulations limited inactivated vaccines to those States not yet requiring elimination of infected herds. USDA further noted its intent to eliminate all vaccines by January 1, 1970. A major turning point in dealing with hog cholera had finally been reached. The country was committed to a stamping-out program without reliance on vaccines to control the disease.

Those in favor of this action and those opposed agreed on one fundamental fact: with the elimination of vaccines, the bridges to the past had been burned. Future handling of hog cholera would depend on strict adherence to the search-and-destroy techniques necessary for successful disease eradication.

The next few years were to demonstrate that removal of vaccines, while eliminating one big obstacle to final eradication, did not end all problems.

Funding in Mid-Program Years

Costs rose as the program expanded and States moved into phases requiring the payment of indemnities. Total State and Federal costs for fiscal years 1966 through 1970 were \$45.8 million, three times higher than in early program years. Indemnities were about 30 percent of this total, in contrast with the less than 2 percent paid for indemnities in the early years.

Program costs in fiscal year 1970 were the highest up to that time, involving \$8 million in Federal funds and \$6.4 million in State appropriations. Although rising, these amounts were still less than estimated by USDA in 1960 prior to initiation of the program.

By that time, however, increased appropriations were more difficult to obtain. Federal spending for most programs was placed under increasing restraints starting in 1968. Many State legislatures were also placing constraints on spending. In addition, there was some air of complacency about the program. Confirmed cases in 1970 were the fewest in 4 years and less than half those found in 1969.

This comfortable attitude about program progress led to the hope that existing funding levels would be sufficient to complete the effort. This was changed by events after 1970, which required several years of increased spending.

Subchapter C

The Emergency Years (1970-77)

January 1, 1970, found all but three States (New York, New Hampshire, and Maine) in the final two phases of the program—phases requiring the prompt depopulation of infected herds. Twenty-two States were either in Phase IV—working to stay without outbreaks for a year—or had already reached “hog cholera-free” status. The three States still in Phase II had less than 1 percent of the Nation’s swine, were experiencing little or no hog cholera, and were delayed in advancing into Phases III or IV by difficulties in obtaining State indemnity funds. (Fig. 3-21.)

But 1969 had been a bad year for outbreaks. Although 24 States had no hog cholera, and 7 States reported two-thirds of the national total, the 1,481 confirmed cases in 1969 were more than twice the annual average for the preceding 3 years. Sources of outbreaks in 1969 showed that over half came from movement of swine into farm herds and another 30 percent came from disease spread within infected neighborhoods. Cases due to feeding uncooked garbage also rose—to about 10 percent from the national total.

January 1, 1970

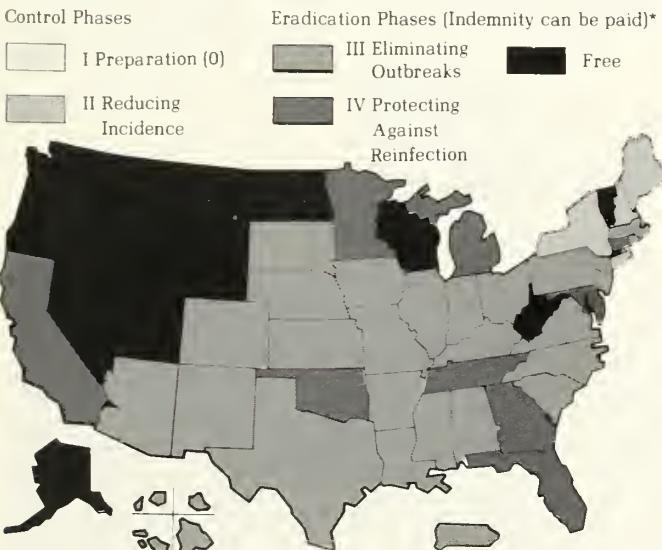


Figure 3-21.—Status of the cooperative State-Federal eradication program, January 1, 1970.

It was evident that in many parts of the country undetected infected or exposed swine were moving in market channels and causing a burst of outbreaks as they were dispersed to many different farms.

Garbage cooking enforcement—always difficult—was not as effective as required for eradication, and was further complicated by the fact that some States were still salvaging apparently healthy swine from infected herds. This increased the risk of infected pork reaching swine if garbage was not properly cooked.

The worst outbreak areas were in Missouri, Texas, the Carolinas, Arkansas, Maryland, and Virginia. (Fig. 3-22.) Study of cases in the outbreak areas showed similarities. Except for Virginia, all had experienced a decline in outbreaks in 1968 leading to some feeling that the work was about over. Then hog cholera virus, often of low virulence, spread through feeder pigs moving through markets and back to farms. As virulence built in the newly infected herds, the virus spread within the neighborhood and then back again to the markets, starting the cycle over again.

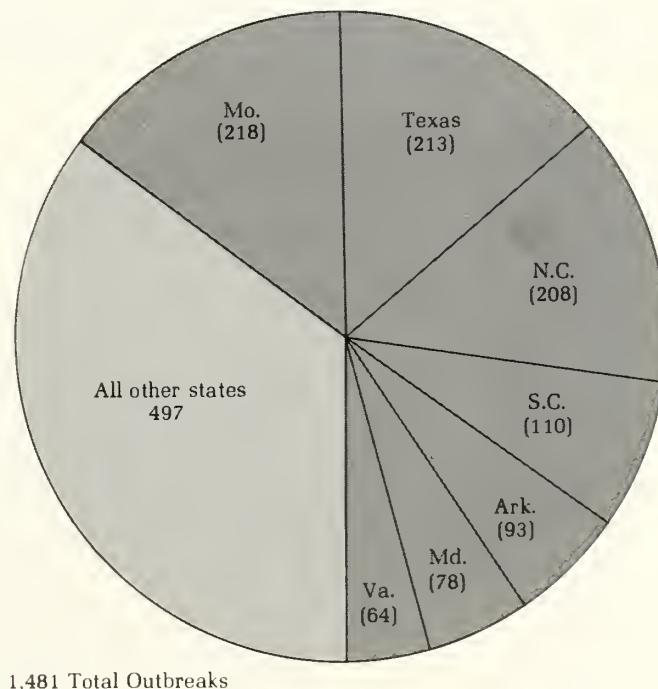


Figure 3-22.—In 1969, two-thirds of all the hog cholera infection was concentrated in seven States.

The depressing feature of the 1969 experience was that remedies were not only known but were already supposed to be in operation. A particular embarrassment to regulatory agencies was that this type of cycle had been predicted by opponents of vaccine withdrawal if program controls were not effectively carried out.

Although shipping regulations dating back to 1962 included a system of approved swine markets to insure good facilities and records, swine inspection, and feeder pig identification, it was clear that the requirements were not being fully met. The same was true of quarantine restrictions that should have kept the disease from leaving an infected farm.

Action had started during 1969 to shore up these aspects of the program. In June, the USAHA committee met in special session and pressed all States to strengthen enforcement of shipping regulations and quarantine measures. That same month the USDA Animal Health Division announced that henceforth hog cholera would receive first priority in use of Federal disease control funds and personnel. Over the next few months, a series of regional meetings set up the procedures for handling the program on a top priority basis in the field.

Federal action to support State quarantine efforts was taken in July 1969, for the first time in the hog cholera program. Adjacent portions of Delaware, Maryland, and Virginia were placed under Federal as well as State quarantine. (Fig. 3-23, 24, 25.)

It was noted that action in Georgia in 1968 to

close swine markets statewide to combat widespread hog cholera had produced results. It was a drastic step, producing many short-range economic disruptions and consequent political repercussions. But something stringent was needed, and a number of other States that had problems in 1969 took similar action.

Salvage of apparently healthy swine from infected herds in Phase III States was discontinued by some States and curtailed in others. This practice, needed when adopted in 1966, was in many States producing more damage than benefit by the end of 1969. Salvage was discontinued nationwide in March 1971.

Garbage-feeding enforcement was reexamined. Enforcement actions were stepped up in some States. Others, usually those with few garbage-fed swine, initiated legal action leading to prohibition of this method of feeding pigs.

By the end of 1970, joint State-Federal quarantines in outbreak areas had become routine. Standards for swine markets were strengthened. States expanded use of stop orders for movement of pigs in infected areas. This system, an outgrowth of the 1968 action in Georgia, stopped swine movement until feeder pigs were inspected on the farm before consignment to market. Other States adopted a policy of allowing feeder pigs to be sold only through authorized feeder pig sales, where disease history of the herd of origin could be determined.

Cases dropped by over 50 percent in 1970 as compared with 1969—from 1,481 to 679.



Figure 3-23.—Federal quarantines for hog cholera were first used in July 1969 when the Del-Mar-Va Peninsula was placed under quarantine. In Delaware, State policemen helped regulatory workers enforce the quarantine by setting up check points at bridges over a canal running across the northern part of the state.



Figure 3-24.—A livestock inspector explains the provisions of Federal quarantines for hog cholera to a trucker who had stopped at the quarantine check point. In late 1969, Federal quarantines began to be systematically placed in all areas where outbreaks occurred.

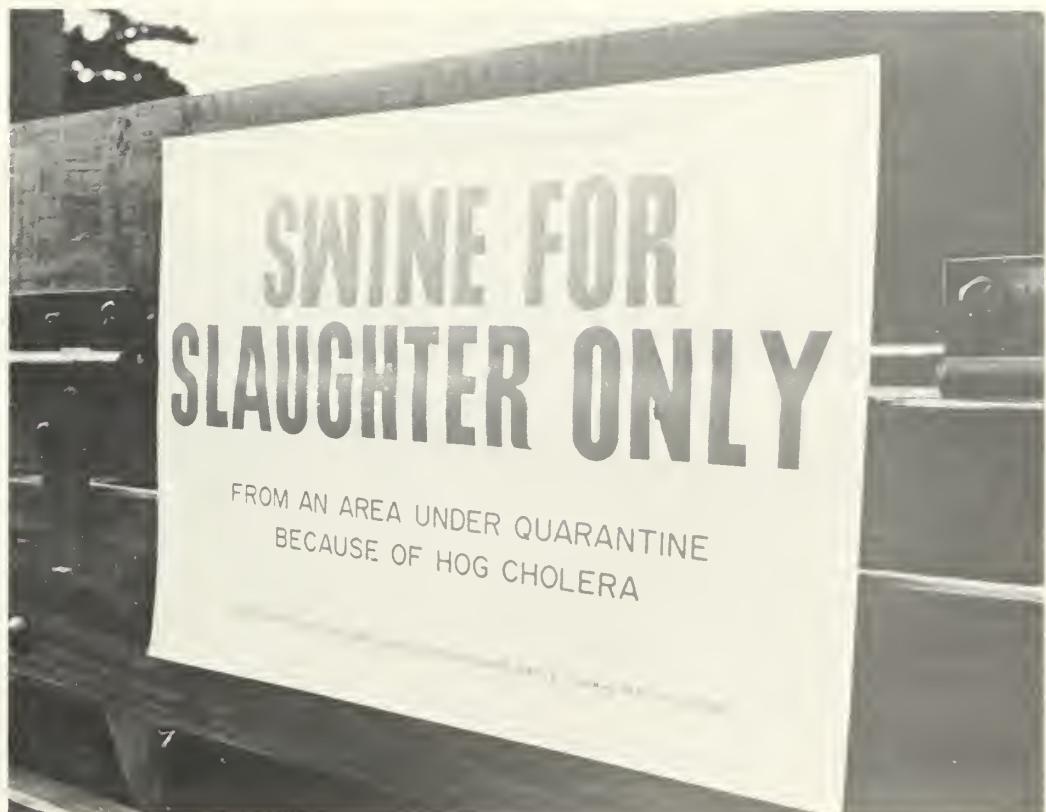


Figure 3-25.—Changes were made in Federal quarantine regulations following the Del-Mar-Va experience to allow for shipment of healthy, unexposed slaughter swine if they were inspected on the farm and then shipped directly to slaughter or to market for sale or slaughter. No feeder pigs or breeder swine could move interstate from an area under Federal quarantine for hog cholera.

"The Dismal Swamp Operation"

A major development in the fall of 1970, in terms of future impact on the program, was the use of an emergency task force in handling a persistent hog cholera problem in the Dismal Swamp area of North Carolina and Virginia. (Fig. 3-26, 27, 28, 29, 30, 31, 32, 33.)

The task force approach had previously been used in Maryland, Oklahoma, and North Dakota to combat outbreak clusters. Even though these were relatively small-scale efforts, the results showed that the system was effective. For the Dismal Swamp problem, it was decided to go in on a large scale.

In the first 6 months of 1970, 36 percent of the total outbreaks in the Nation came from Virginia and North Carolina. Farm-to-farm spread in the infected area was occurring at a rate not previously encountered. In August, the State Veterinarians in the two States and the Animal Health Division of USDA decided to attack the Dismal Swamp problem with a united group under a single director. The group would operate across State lines.

On September 8, 1970, 11 adjacent counties in southern Virginia and northeastern North Carolina were placed under Federal and State quarantines. A USDA veterinarian, whose long career had included experience in handling foot-and-mouth disease in Mexico during the 1950's, was appointed coordinator and empowered to exercise both Federal and State authority. Central headquarters space was secured within the quarantined area in Suffolk, Virginia, and special telephone lines installed. Veterinary epidemiologists and livestock

inspectors were moved in from other States. Field diagnostic laboratories were set up in the area.

In addition to State and Federal personnel from Virginia and North Carolina, USDA supplied people from 40 other States. The States of Maryland, Alabama, and Wisconsin also sent people. At peak strength, the task force had over 170 people in the field within the relatively small quarantine area.

The key to the operation was rapid inspection of all pigs in the quarantine area, followup of all leads growing out of the histories assembled, reinspection of all herds with illness, and rapid laboratory support for diagnosis. No swine could move within the area until cleared by task force personnel.

The operation lasted 11 weeks, concluding just before Thanksgiving. During this period the task force located and destroyed over 12,000 swine on about 70 premises found to be infected or exposed. It was expensive—with program and indemnity costs of close to \$1 million—but it was effective. The persistent hog cholera in the Dismal Swamp area was eliminated.

The next year there were only three hog cholera outbreaks confirmed in Virginia, as compared with 116 in 1970. In North Carolina, cases dropped from 140 in 1970 to 24 in 1971.

This also set the pattern for handling potentially explosive outbreak areas. While most cases throughout the country were isolated and could be effectively handled by resident personnel, the handling of persistent outbreaks with a well-staffed, single-purpose task force served to stamp out hog cholera in pockets that threatened to get out of hand.

Figure 3-26a.





Figure 3-27.—Roving patrols of inspectors checked truckers to make sure they were in compliance with quarantine regulations. Feeder pigs and breeding stock could not be moved. Market hogs could go to slaughter, but only if they were inspected on the farm prior to shipment.

Figure 3-26b.—The "Dismal Swamp Operation" got underway on September 8, 1970, when 11 counties and 4 cities in southeastern Virginia and northeastern North Carolina were placed under State and Federal quarantines. The 11-week operation successfully eliminated a persistent pocket of infection in that area and set the pattern for handling explosive outbreak situations, both for hog cholera and for other diseases handled on an emergency basis.

(Caption refers to both Figure 3-26a and 3-26b)



Figure 3-28.—Losing your swine herd is not a pleasant experience. Even though indemnities were designed to compensate a farmer for his monetary losses, there are often intangibles that can't be covered by money.



Figure 3-29.—All hogs in infected and exposed herds were destroyed. On most farms, burying the animals was the preferred method of disposal. Both North Carolina and Virginia agreed to stop salvaging apparently healthy market-weight hogs in infected and exposed herds as a condition for beginning the two-state Dismal Swamp operation. Salvage was ended nationwide in March 1971.



Figure 3-30.—Equipment used to dig holes and bury the hogs had to be thoroughly cleaned and disinfected.





Figure 3-31.—Survey work was the heart of the Dismal Swamp operation. Swine herds were checked and rechecked until it could be determined that hog cholera was not present. Here, veterinarians at a field substation in Virginia mapped out plans for the following day's work.

Figure 3-32.—One precaution strictly adhered to throughout the entire operation was cleaning and disinfecting boots when entering or leaving a farm and changing coveralls for each farm visit.

Figure 3-33.—The biggest part of disposal operation consisted of plain, hard, hot work.



1971

The only pockets of infection found in early 1971 were in North Carolina and Texas. North Carolina appeared to solve the problem by the end of June—with no further cases reported that year. Texas, with USDA, employed a task force in the spring months to combat an area of persistent infection, with apparent success by summer. Nineteen other States had isolated outbreaks which were contained and eliminated. Twenty-nine States were without any confirmed cases in 1971.

The 118 cases in 1971 were the lowest number for any year since nationwide reports became available in 1964 and 1965. The year also saw the widest ratio between suspicious reports and confirmed cases of any program year to that time, with 3,878 suspicious reports being investigated to find the 118 that actually were hog cholera. This 3 percent confirmation rate indicated that missed infection was much less likely than in earlier years.

Federal shares of indemnity payments were increased to 75 percent in States in Phase IV and to 90 percent in States declared "hog cholera free." This action eased the potential burden on State funds in such States, and was justified on the basis that in these States the risk was from outside; and, therefore, Federal support in the event of an outbreak should be greater.

By the end of 1971, all biologics manufacturers had voluntarily surrendered their licenses to produce hog cholera vaccine and serum. Small amounts for export sales had been produced since July of 1969, but by the end of 1971 all commercial production of hog cholera biologics ceased in the United States. During this period, USDA also initiated pickup of stocks of vaccine still in private hands, although there was no way of knowing exactly where all such stocks were located.

The hog cholera situation looked good in the fall of 1971. No areas of infection were known. Field organization and laboratory support to handle threatening situations was believed to be much advanced over previous periods. Knowledge of how the disease spread had been improved during the program years, including studies of the effect of insect vectors carried out during earlier outbreaks in North Dakota, Maryland, and the Dismal Swamp. Results showed that insect control should be part of program action in outbreak areas with high swine numbers and a heavy insect population particularly if wetlands or swamp areas were present.

In September, a group representing the various public and private organizations interested in the program met in Washington, D.C., to draw up

recommendations for deciding when the disease should be considered eradicated; how stocks of hog cholera virus scattered in laboratories, universities, and individual hands could be secured; and what the surveillance technique should be in the final part of the program.

But members of this group, as well as the hog cholera committees of USAHA, LCI, and USDA, had been through earlier periods of optimism and all warned in the fall and winter of 1971-72 of the risk of complacency regarding hog cholera.

Their concern was well founded. Virulent hog cholera, found in South Texas in December of 1971, continued on into the next year.

1972

In January 1972, all 22 cases in the country were reported from Texas. In March, hog cholera broke out in eastern North Carolina and a task force was established in a six-county area to combat the problem. Texas continued to report cases from southern counties through June.

The strongest public reaction, however, started in late August with reports of hog cholera in Darke County in southern Ohio. By September, Indiana reported hog cholera in Carroll County—a county that, according to a local newspaper report, had a swine population of over 1,000 per square mile. Much of this large population had resulted from a relatively new practice of importing feeder pigs from the South to feed out in the county. Feeder pig dealers were also located in the county who imported pigs from the South and then resold into other States.

The rising number of cases in Carroll County aroused people throughout the State. Indiana, even with its large swine population, had not experienced any concentrated series of outbreaks prior to the Carroll County cases in September 1972. During the preceding 2-1/2 years, Indiana had reported only 14 cases, with none in the first half of 1972. However, in the last half of 1972—largely due to the Carroll County outbreak—43 cases were confirmed in Indiana. (Fig. 3-34.)

An intensive task force operation was mounted in Carroll County. Actions taken were stringent. In addition to the usual areawide investigation by task force teams, all hunting was banned to minimize mechanical spread of disease through hunters' boots and hunting dogs. Certain infected farms were treated to reduce insect numbers as the large fly population—a result of an unusually wet season—was implicated as a mechanical means of spreading the disease.



Figure 3-34.—The task force eventually had to destroy some 17,000 hogs in Carroll County, Indiana, in order to bring that outbreak under control.

As the task force sought out infected and exposed herds—eventually resulting in 17,000 Carroll County hogs being destroyed—demands rose for additional action, ranging from return to vaccine to Federal subsidies for herd owners beyond indemnity paid for actual value of swine destroyed. At one point, the Under Secretary of Agriculture flew in from Washington to appear at a mass meeting in the county to receive the concerns and complaints of swine producers and dealers.

Fortunately, the work of the task force produced rapid results. All quarantines had been lifted by December and the worry of many producers that hog cholera was going to continue to spread was removed.

Study of the case histories in the Ohio and Indiana outbreaks led back through Kentucky into feeder pig markets in Tennessee. The pattern that finally emerged in this series of events showed hog cholera moving through markets from the southeast into Kentucky, then to Ohio and Indiana, and from Indiana to New Jersey—from where it moved to Puerto Rico, Virginia, North Carolina, and probably Pennsylvania. The Carroll County infection appeared to have been introduced by the illegal retention for breeding purposes of lightweight sows ostensibly brought in as feeder pigs.

Swine industry leaders throughout the country became very concerned over the apparent lack of effectiveness of program controls that allowed this type of spread to take place. Along with representatives of the States, they descended on USDA in early fall, demanding stronger Federal action to prevent such situations in the future.

On October 11, 1972, the Secretary of Agriculture declared a National Hog Cholera Emergency. This empowered him to immediately draw on all resources available to him to combat the disease. This put more money, more people, and more urgency into the national effort. Within USDA, the program was placed under the Emergency Programs Staff of APHIS' Veterinary Services.¹

A significant additional action was a decision to place Federal and State "hold orders" barring swine movement in entire States where an outbreak had occurred that involved swine moving through markets. This step, aimed at bringing swine movement to a standstill while the extent of disease spread was being determined, was carried out for

¹A USDA reorganization in the fall of 1971 and spring of 1972 placed the regulatory functions of the Agricultural Research Service (ARS) into a separate agency, the Animal and Plant Health Inspection Service (APHIS). Veterinary Services incorporated the functions of both the Animal Health Division and the Veterinary Biologics Division in the previous organization under ARS.

the first time in New Jersey and Pennsylvania in December 1972.

By this time, a policy of destroying exposed herds as well as infected herds was in effect. This policy, initiated in 1969, allowed removal of exposed herds determined to be a risk to the general swine population and enabled quick removal of incipient infection without waiting for the disease to appear in a clinically observable form. In 1972, with 205 confirmed cases in the country, pigs in 428 additional herds were destroyed due to exposure to the disease. From 1969 through 1977, a period in which 2,524 confirmed cases were found, an additional 3,189 exposed herds were removed.

1973

The 1972 experience did not repeat in 1973. Only 16 cases were reported in 1973—all in the first 6 months. These were isolated cases in eight States and further spread was prevented.

1974

The following year looked even better. One case was found in February in Mississippi and four cases in May in Puerto Rico. By the end of 1974, the country had been without confirmed hog cholera for 8 months. The USAHA committee meeting in October, devoted its annual report to recommendations for maintaining surveillance over possible means of detecting and preventing infection from within and without the country, with particular emphasis on the U.S.-Mexico border.

1975-76: The Final Episodes

The first 6 months of 1975 were also free of confirmed cases. For 14 months—from early May 1974 through late June 1975—no hog cholera was found in the 50 States and Puerto Rico.

During this time, field investigations of suspicious reports continued to be carried out. In addition, veterinary diagnostic laboratories were by this time screening for hog cholera all swine tissues they received, whether or not the clinician suspected the disease.

One such submission, sent to the Texas Veterinary Medical Diagnostic Laboratory on June 28, 1975, was positive for hog cholera on the routine screening. These samples, plus tissues from two more sick swine in the herd of origin, were sent to USDA's National Veterinary Services Laboratories at Ames, Iowa. On July 4 all were reported as

positive for hog cholera. On July 5, the herd was destroyed.

By mid-1975—14 years into the eradication program—each new case triggered an exhaustive investigation. The 1975 Texas case and the final 1976 cases in the eastern United States resulted in investigations illustrative of the system developed during previous years. The following outbreak histories are drawn from these detailed field studies.

Hereford, Texas, Outbreak—1975

The owner of a small livestock market in the Texas Panhandle bought and sold swine and cattle. Hogs too light for slaughter were retained on the premises. On June 9, 1975, sick hogs were noted. The first death was on June 12. The owner injected antibiotics. On June 19, a local veterinary practitioner was called. Hog cholera was not initially suspected—it had been 2 years since the disease had been found in Texas. On June 28, the practitioner sent tissue samples to the Texas Veterinary Medical Diagnostic Laboratory, which led to a positive hog cholera finding.

While the market owner was cooperative, it was found that he did not keep specific records of purchases and sales. It was necessary for the investigating team to work from checks, bank statements, and other indirect means to chart movements to and from the market. In order to cover a possible long incubation period, it was decided to go back to April 1 to trace incoming shipments and to May 1 for outgoing shipments.

The market had received shipments from 229 herds since April 1. Eleven could not be traced back. Twenty had sold out. The remaining 198—including 23 in New Mexico—were found and tissue samples were taken. All herds were negative for hog cholera except one—a herd located only 3 miles from the market.

This herd was first visited on July 10, within a week of the original diagnosis. No sick pigs were noted, but blood serum was collected. On July 12, the owner called the task force and reported one sick pig, which was also sampled. Blood serum test results strongly indicated that hog cholera was—or had been—present in the herd.

On May 7, 28, and 31, pigs from this herd had gone to the local livestock market where illness had been noted on June 9 and hog cholera confirmed on July 4.

This herd was destroyed on July 21. Several animals displayed post mortem findings compatible with hog cholera.

A source for this infection was not found. Herds supplying pigs to the infected herd were tested. All were negative, except for two that had sold out and could not be tested. The infected herd was located several hundred miles from Mexico and speculation that the infection might have been introduced from there was not substantiated.

Between May 1 and July 5, the owner of the infected market had sold swine that reached 30 farms—24 in Texas and 6 in Oklahoma. All but one of the Oklahoma herds had been involved through sales from the Texas market to the Oklahoma City stockyards and from there back to farms. All 30 of these Texas and Oklahoma farms were depopulated as potentially exposed.

All were sampled at time of slaughter. All but one were negative for hog cholera. This herd had received boars from the Texas market on May 24 and June 12. It showed blood serum results that indicated experience with hog cholera virus.

In addition, 58 herds receiving swine from the Oklahoma City Stockyards at the same time the Texas pigs were in the yards were kept under surveillance until it was determined that they were not infected.

Swine inoculation at USDA's National Veterinary Services Laboratories with the hog cholera virus isolated from the original Texas outbreak showed the virus to be highly virulent and readily transmitted to contact pigs. It is probable that the rapid searching out and destruction of exposed herds carried out by the task force was significant in preventing further spread.

The Texas-Oklahoma outbreak went no further. No other cases were reported in the United States in 1975.

New Jersey and New England—1976

January of 1976 went by with no reported cases. It was a bad winter for livestock in New Jersey and New England, with much moisture and wide temperature fluctuation. Sickness and deaths were high among garbage-fed swine herds. As many of these operations habitually had health problems beyond those considered acceptable by grain feeders, no special concern was aroused. Few of these owners utilized the services of a veterinarian.

New Jersey livestock inspectors continued routine sampling of dead pigs on the farms they visited. In addition, veterinary diagnosticians obtained tissues from two herds with high death losses. Hog cholera examination at a State laboratory was negative. In late February—by which time there were three herds that had lost several hundred swine—tissues

were sent to the National Veterinary Services Laboratories for testing. On February 24, results were positive for hog cholera.

Subsequent examination into the reason for the differing laboratory results raised the possibility that the negative report in New Jersey was due to malfunctioning equipment on the microscope used in the fluorescent antibody procedure. No hog cholera had been identified in New Jersey since 1973, and the last cluster of outbreaks was in the fall of 1972—the result of spread from the outbreak in Carroll County, Indiana.

To the north, in Rhode Island, the owner of a garbage-fed herd, who conducted a large feeding and breeding operation, noted what seemed to be excess illness in young pigs. After over a month of treatment with little response, he took some pigs to the University of Rhode Island laboratory, from where suspicion of hog cholera was reported to State officials. Tissues went to the National Veterinary Services Laboratories and were positive for hog cholera on February 28. As in New Jersey, no hog cholera had been reported from Rhode Island since 1973. The same was true for Massachusetts and New Hampshire, where there were also concentrations of garbage-fed herds which were to be rapidly involved in the 1976 outbreaks.

Task forces, immediately activated in New Jersey and New England, (Fig. 3-35.) started uncovering additional positive and suspect herds as they tried to trace exposure to and from the initial infected herds.

In New Jersey, five more infected herds were found in the next 3 weeks. All but one was within a mile of the first infection. One more infected herd was found 10 miles to the south, on a farm that received bakery waste by truck from one of the herds in the New Jersey outbreak area.

The initial depopulations of the infected and exposed herds removed all but two herds in the outbreak area. Both of these were considered a high risk and both were subjected to a continuing inspection and blood serum analysis.

It was concluded that spread within the outbreak area was mechanical, through traffic of people, vehicles, and wild and domestic animals. It was also concluded that the infected herds had all been exposed prior to the first diagnosis on February 24. The initial source of infection could not be factually determined.

The investigation proceeded to examination of all garbage-fed herds in New Jersey. Ten herds in the Cape May area in the southeastern part of the State were placed in the high risk category and subjected

Areas Quarantined
in 1976 Outbreak

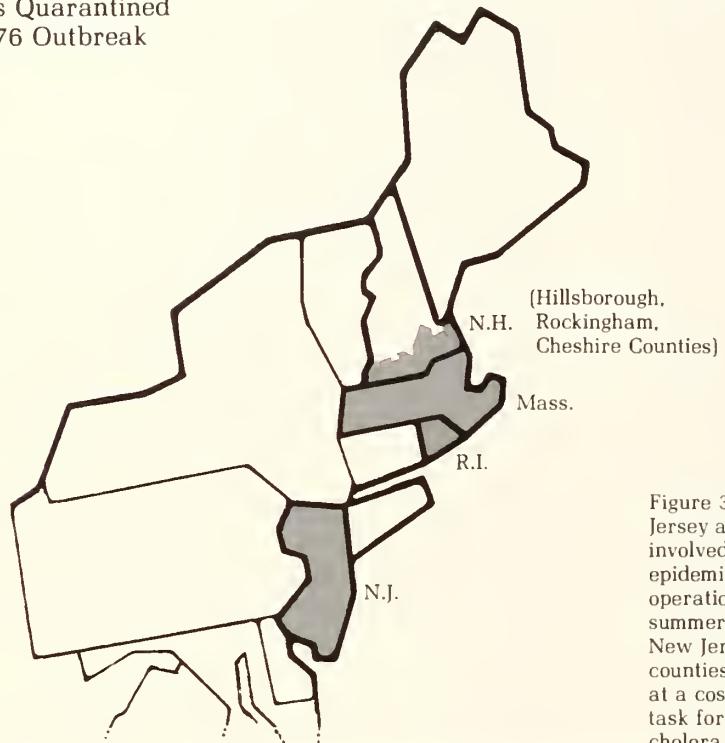


Figure 3-35.—Task force operations were set up in both New Jersey and New England to tackle the 1976 infection there. This involved perhaps some of the most complex and thorough epidemiology of the entire eradication program. During these operations, which started in late February and ended late that summer, Federal quarantines were placed on the entire states of New Jersey, Rhode Island, and Massachusetts and on three counties in New Hampshire. A total of 24,000 hogs was destroyed at a cost of \$2.9 million in indemnities. Operational costs of the task forces totaled an additional \$2.2 million. The last case of hog cholera in the United States was diagnosed on August 1, 1976, in a swine herd near Cape May, New Jersey.





to followup surveillance and testing. No evidence of infection was found in the high risk herds or on the previously infected farms that were repopulated. By May 10, all New Jersey quarantines had been released.

The New England task force, in addition to the problem of finding and eliminating infected and exposed herds, faced lack of cooperation from many owners—an attitude that some had carried forward from the Vesicular Exanthema Program over 20 years before. Investigators attempting to establish patterns of swine movement met with claims of no information, disbelief in the presence of hog cholera, and in some cases what appeared to be false information.

As attempts at traceback continued, along with areawide inspections, the trail led back to Massachusetts. Six additional infected herds were found by the end of April—all in Massachusetts except for one in New Hampshire. One of these positive cases led to a Massachusetts garbage feeder who also dealt in swine, with constant movements in and out. This dealer resisted efforts to sample his herd, claiming that some animals had been vaccinated in their herds of origin and would be expected to show positive results.

There were persistent rumors of the use of hog cholera vaccines throughout the course of the investigation in New England, even though for all practical purposes vaccines had been outlawed nationwide 6 years before. While no legally acceptable evidence proving such use was ever obtained, field investigators eventually concluded that old supplies of outdated vaccines were probably used in some herds and contributed to the type of chronic hog cholera present in the area.

In spite of resistance, the Massachusetts dealer's herd was sampled. Hog cholera virus was found in the tonsils of 1 animal, and 99 others showed high levels of hog cholera antibodies in their blood. The herd was depopulated. Samples taken at slaughter showed four more animals positive for hog cholera.

Veterinarians working on the case concluded that these results, along with post mortem lesions, indicated that this herd contained both animals vaccinated against hog cholera and animals chronically infected with hog cholera virus.

Another revolving dealer herd was found positive on April 2. This man bought, sold, transported, and fed hogs to and from New England, Pennsylvania, Maryland, and Delaware. While he could not remember all his transactions, all known herds of origin were sampled with negative results. Three farms receiving pigs from this dealer were depopulated as exposed. As the owner had

considerable traffic with the Rhode Island herd first found infected, it is possible that his infection entered from that source.

On April 29, a New Hampshire garbage-fed breeder/feeder operation with over 700 swine was found to be infected. This herd was just over the Massachusetts border and was closely associated with operations in that State. Six animals of 141 sampled were hog cholera positive. Blood serum tests suggested use of both hog cholera vaccine and bovine virus diarrhea vaccine. The owners denied using hog cholera vaccine, but did say bovine virus diarrhea vaccine was used in March. The owners first claimed no swine were added to the herd and that they sold only to slaughter. Later, four other herds were depopulated as exposed after the task force developed information they had received swine from this New Hampshire herd.

No more positive cases were found in New England that spring and all quarantines were removed by June 4.

Task force veterinarians remained uneasy over the situation. Definitive information on swine movements was scarce and many case histories were not as complete as desired. The field force could not be sure that the type of chronic hog cholera found in this outbreak was gone from the area or that owners would cooperate in reporting future illness.

This led to a meeting of the USDA Advisory Committee in Washington in mid-June. Members were concerned over rumors of vaccine use in New England as well as lack of owner cooperation in fighting the outbreak. The Committee urged USDA to take additional steps to complete the program and retain public confidence that this had in fact been accomplished.

Steps recommended included reestablishment of quarantines in New England and reactivation of State hog cholera eradication committees to help obtain better owner cooperation.

In June, USDA convened a group of authorities in virus diseases to act as advisors in developing a plan to deal with the blood serum-positive herds still being found in surveillance testing. The final plan set up a system to categorize such herds according to risk, place restrictions appropriate to degree of risk, and develop individual plans for herd depopulation when test results indicated this was necessary.

By July, even though the New England quarantines had been lifted and the task force was no longer in formal operation, it had been decided that confidence could not be placed in the fact that hog

cholera had not been found in the area since April 29. Even though hog cholera virus had not been found since that time, blood test results from extensive sampling instituted during April continued to disclose herds with titers indicating some type of experience with hog cholera virus from vaccines or other exposure. This survey had been instituted by task force veterinarians when it became evident that lack of cooperation by owners was blocking any real opportunity to trace down residual infection by usual disease investigation procedures.

Then, on July 17, another garbage-fed feeder/breeder herd in Massachusetts was found to be infected. This herd was first sampled in mid-April and had been placed in the high risk category. Although no virus was found, some high blood antibody titers were disclosed that investigators believed were due to vaccination. The owner denied using hog cholera vaccine in these animals.

Continued sampling of the herd led to disclosure of hog cholera virus on July 17 in tonsil tissue from the sampled swine. When the herd was slaughtered on July 20, clinical hog cholera was noted in some young pigs—and most of these were hog cholera positive in subsequent laboratory tests.

On July 18, the New England task force was reactivated. On July 20, Federal quarantines were placed on all of Massachusetts and Rhode Island as well as on southern New Hampshire and eastern Connecticut. In early August, a new Massachusetts Hog Cholera Eradication Committee was formed, which met weekly thereafter. The producers on this committee were helpful in initiating and carrying out the plan to finally determine if hog cholera was still in the area. New Hampshire also formed an eradication committee.

The areawide survey and sampling plan, started in April, was concluded in August. During this extensive sweep, 18,456 swine were sampled in 736 herds. Of these, 137 herds showed some antibody titers and 32 were placed in the high risk category.

One of the high risk herds had already been found infected, on July 17, and was gone. Two more were depopulated as exposed after rising antibody titers indicated probability of virus activity. One was sold for slaughter. The others were kept under close control and laboratory tested—with individual herd plans to insure no risk to other swine until a final decision could be made on each.

No further evidence of hog cholera virus activity was found. On September 13, the Federal quarantines were removed. On September 30, the task force closed, but surveillance activities continued beyond this date until all herds were eventually cleared.

The Final Case

Meanwhile, in the Cape May area in southeastern New Jersey, illness developed in 1 of the 10 high risk herds kept under surveillance following the outbreaks earlier in 1976. Tissues from this herd were hog cholera positive on August 1, 1976.

Although the owner denied any purchases, investigators came to believe the herd became infected during June, probably through addition of culled sows from a herd exposed during the winter outbreaks. Resampling of this source herd showed all animals with rising blood titers and the herd was also depopulated, as were six others that contained swine purchased from the herd found infected on August 1. Hog cholera virus was isolated from one of these at time of depopulation.

The August isolations in New Jersey proved to be the final cases of hog cholera in the United States during the eradication program. Surveillance continued throughout 1977, with special operations in New England, New Jersey, and along the U.S.-Mexico border. During that year, 778 suspicious reports were investigated, but no hog cholera virus was found.

On January 31, 1978—18 months after the last case and just over 16 years after passage of Federal legislation enabling the program—the Secretary of Agriculture terminated the 1972 National Hog Cholera Emergency order and declared the country "hog cholera free." This ended the largest eradication program against a swine disease ever undertaken by any country in the world. (Fig. 3-36.)



Figure 3-36.—On January 31, 1978, in ceremonies on Capitol Hill, Secretary of Agriculture Bob Bergland signed a document officially declaring the United States free of hog cholera. Flanking Secretary Bergland at the signing ceremonies were Rep. Jamie

Whitten (D-Miss.), left, and Rep. Mark Andrews (R-N. Dak.). Also present (rear row, left to right) were Rep. Dawson Mathis (D-Ga.), Rep. Charles Whitley (D-N. Car.), Rep. John Jenrette, Jr. (D-S. Car.), Rep. James Leach (R-Ia.), and Rep. Charles Grassley (R-Ia.).

Funding in Emergency Years

Program costs, which had totaled \$61.3 million in the first 9 years of the program (FY 1961-70), increased to about \$79 million in the final 7 years (FY 1971-77). Federal costs rose above State costs as the Federal portion of indemnities rose from 50 percent to 75 percent or 90 percent depending on State status in the program. Extensive emergency operations were also largely funded from Federal sources. The most expensive year of the entire program was FY 1973, with \$12.6 million from Federal sources and \$4.7 million from the States.

The hog cholera eradication campaign demonstrated an axiom of animal disease eradication—the final years are the most expensive in relation to the cases found.

At the beginning of 1966, about 12 percent of the

swine population was in States where infected herds were promptly condemned and eliminated. By the end of 1970, this coverage had risen to 99.9 percent. During these years, 3,370 confirmed cases were found at a program cost of \$13,578 per confirmed case.

In the final years (1971 through 1977)—a time of extensive investigation and large scale emergency operations—only 364 confirmed cases were found, at a program cost per case of about \$217,000.

But if these cases had not been found, the program would not have been completed. There was continuing recognition during the final years that it was essential to pursue these last cases by all means necessary. Increased funds were provided to conduct the emergency activities and conclude the program.

Chapter IV

Evaluation

The history of hog cholera in the United States, from first appearance to final eradication, is a story of changing perceptions by swine producers and scientists and other professionals involved in the problem.

The key to the successful eradication effort was the melding of many motivations and understandings into a sustained cooperative effort over almost 30 years—from the forming in 1950 of the first formal national committee dedicated to eradication to the final declaration of eradication on January 31, 1978.

The sweep of this history—almost a century and a half—provides a basis for some observations about the hog cholera eradication program and reasons for its success.

Commitment to a Goal

When a dangerous disease of animals is introduced into the United States, public reaction is usually supportive of a stamping out effort. Examples include the nine times between 1870 and 1929 that foot-and-mouth disease was introduced; and, more recently, the appearance of Venezuelan Equine Encephalitis in south Texas in the summer of 1971 and the entry into southern California later that year of a highly fatal type of Newcastle disease of poultry. All promptly aroused demands for action. Public attitudes were that this country did not know through experience if it could live with the problem and did not propose to find out.

Hog cholera was different. After over a century of adjustment, the swine industry knew how to coexist with hog cholera. Eradication remained only a hope—and there were long periods when it was not seriously discussed or regarded as possible.

The hope persisted, however, beyond the huge early losses from the 1830's to World War I through the period of various immunizing procedures from 1914 to the beginning of the eradication program. The advent of improved vaccines gave farsighted leaders in the swine industry and allied groups a basis for believing that the hope might be turned into reality.

So—having experienced several generations of living with the disease—swine producers were ready to adopt and hold to the goal of eradication when a realistic way appeared to remove the continuing economic burden of the disease. While some—including a few swine producers—suggested altering the program to one of disease control rather than eradication, the organized swine industry never deviated from insistence on eradication as the sole acceptable aim.

Reasons for Success

Although there must be enough scientific and technical knowledge at the beginning of a program to give reasonable hope of success, such knowledge alone does not insure success of an eradication effort against an established disease.

Success is dependent on public acceptance of both the need for the program and of the inconvenience and restrictions required for completion. In the United States, this requires active participation of many public agencies and private groups and interests. Sustained cooperative action is necessary if the goal is to be reached. The program to eradicate hog cholera succeeded because these conditions were met.

Among the many individuals and groups who made vital contributions to the program, the key factor—making it possible for others to be effective—was the leadership exercised by the swine industry. Strong and informed industry leaders caused things to happen rather than waiting to be stimulated. They maintained pressure on the public agencies and scientific community to solve problems that arose—and they participated in the problem solving. The industry did not waver from the goal of eradication—even in times of trial—and never advocated a retreat to the past.

With this type of support, the three national hog cholera eradication committees were able to maintain a productive and noncompetitive relationship. Industry attitudes and committee actions gave strong backing to the State and Federal regulatory agencies that carried the load of day-to-day program activities.

Other than Federal regulation of hog cholera biologics, neither State nor Federal regulatory officials devoted systematic effort to hog cholera prior to 1960. Swine producers and practicing veterinarians were left to face the problem with little assistance except from scientists doing research on the disease and from producers of hog cholera biologics. The actions of the swine industry and allied groups that resulted in Federal legislation calling for hog cholera eradication gave a clear mandate to regulatory agencies to implement and carry out an eradication program.

Hog cholera research had always—and properly—been influenced by public needs. In the early years, the studies were largely devoted to learning how to live with the problem. There was concern that the swine industry might not survive the waves of outbreaks that occurred in the last half of the 19th century. Research results—from isolating the

causative agent to the development of effective and increasingly safer types of immunizing agents—enabled sufficient profit from swine production to keep people interested in staying in the business.

Starting in the 1950's, when it became evident that the swine industry wanted to move into an effort to eradicate the disease, the scientific community responded by tackling the technical problems of stamping out the disease in large populations rather than handling the problem in individual herds. Research people, working with field diagnosticians and epidemiologists, met the need for knowledge on rapid, accurate diagnosis; the dynamics of the virus in areawide swine populations and their environments; and the relative risks among the variety of modified viruses used in vaccination.

Individual scientists gave continuing support to the eradication effort by contributing their knowledge and their presence to explaining why problems arose and how they might be solved. These scientists, both in and out of government, got directly involved—and stayed involved—in the often emotional arguments that, without participation, could have led the program astray or stopped it altogether.

A further factor—unique among U.S. animal disease eradication efforts—was the role of commercial producers of veterinary biologics. This industry started its real growth in the early 1900's on a foundation of producing anti-hog cholera serum and virus. While the industry diversified into production of biologics for use against many other diseases of animals, its largest volume of sales at the beginning of the eradication program was still hog cholera vaccines and associated products.

It would have been to the immediate economic benefit of the biologics industry to stay away from involvement in the eradication effort—or even to try to obstruct the program as too risky and not really needed. Instead, recognizing the strong desire of its clients—the swine industry—to eradicate the disease, the biologics industry joined in the program in support of the final aim. Industry leaders sat as members of the several national advisory committees and participated in special technical panels established to solve specific problems. Although there were individuals within the industry with opposite viewpoints, the active positive participation of the biologics industry as a whole was a strong factor in enabling orderly transition from dependence on hog cholera vaccines to removal of these products from public use.

Was It All Worthwhile?

Hog cholera has no human health implications—its impact is purely economic. The real measure of success in an eradication program lies not in the fact that the goal was reached, but in whether or not each public dollar spent returned at least that much in benefits through a reduction in the cost of food production.

An essential figure in making any benefit/cost comparison is the cost of hog cholera at the time the program was initiated. In 1961, USDA had informed the Congress that the estimated annual cost of hog cholera—including disease loss and vaccination cost—was \$40 to \$60 million. This figure could not be based on accurate knowledge of the number of outbreaks really occurring or the rates of death or illness as such data were not then available. As vaccine production was known, it was possible to estimate with more accuracy the cost of vaccination. With development of a nationwide reporting system for hog cholera outbreaks and field studies of each confirmed case, it was possible to reestimate, more specifically, preprogram hog cholera costs. This estimate, made in 1971 as part of a USDA benefit/cost study, gave the annual cost as \$57.4 million just prior to initiation of the program. This included \$15.4 million direct disease loss and \$42 million for cost of vaccine and its administration.

As the bulk of this total was for vaccination cost, it is evident why the swine industry was not interested in any program against hog cholera except one of eradication with elimination of vaccination. Anything less—even if the outbreak numbers were drastically reduced—would have limited economic benefit.

State and Federal program costs over the 15 years of the program—from 1962 through 1977—were about \$140 million. The costliest 12-month period was from July 1972 through June 1973, when \$17.3 million were spent, including \$5.7 million in emergency USDA funds in addition to regular appropriations. The bulk of this expense was for emergency field operations.

But the effort succeeded. Hog cholera outbreaks, which averaged 743 per year from 1964 through 1972, averaged only 10 per year from 1973 through 1976; and none were found in 1977.

Assuming that the preprogram hog cholera cost of \$57.4 million yearly would have continued at that rate in the absence of an eradication program, the total for 1962 through 1977 would have been \$918.4 million. Inclusion of an inflation factor would raise

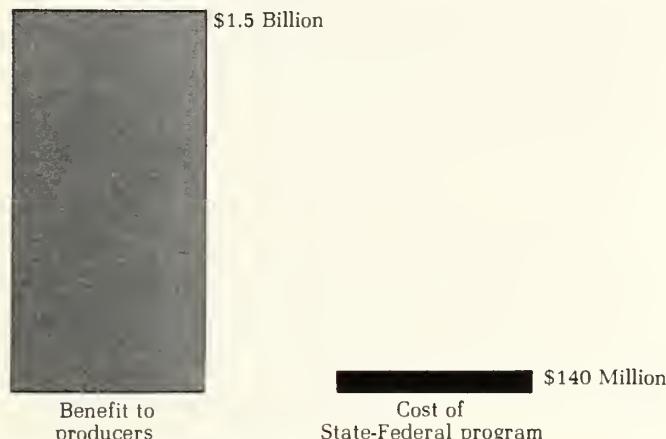


Figure 4-1.—Analysis of the benefits and costs indicated that the hog cholera eradication program more than paid back the investment involved.

this amount to over \$1.5 billion. As program costs over these 16 years were only \$140 million, it seems evident that the program more than paid back the investment. (Fig. 4-1.)

This type of simple comparison, however, does not take into account factors that would need to be included in order to get a closer idea of the actual return on program investment. During the program years—especially the early years—owners were still suffering hog cholera loss without indemnity and were still paying for a high level of vaccination. These were in addition to the tax moneys appropriated for the program. The economic value of an eradication program should also be checked against the comparative value of a control program in addition to comparison to no program. The benefit/cost ratio should not be expressed until after the losses and cost are discounted to reflect "interest" income if the money involved had been used for other purposes.

In 1970, the Animal Health Division of USDA made a benefit/cost projection for the hog cholera eradication program. This analysis, prepared as part of the budget process, was necessarily based on many assumptions on future developments. While not all the assumptions occurred exactly as predicted, the basic patterns held up with later experience.

The analysis projected the end of the eradication program to occur at the end of 1975—including a final 2-year surveillance period. The program actually lasted through 1977. Total number of future outbreaks predicted, however, was much larger than was actually the case. In 1970, the Animal Health Division predicted that 2,025 more confirmed cases would occur before eradication.

Actually, only 1,043 such cases were found from then through the last outbreak in August 1976. So while the 1970 analysis of benefit/cost did not forecast the situation that later developed, the differences were not sufficient to change the relative results of a successful eradication program when compared with a control program or with no program.

In comparing the eradication program to an indefinite high level control program, experience in 1965 was used. In that year, the control phases of the effort were at their peak, and vaccination reached the highest level of the program years. While direct hog cholera loss in 1965 dropped to \$3.2 million—as compared to \$15.4 million just prior to the program—vaccination costs in 1965 were \$45 million. As vaccination would continue indefinitely under a control program, such a program—even with greatly reduced disease loss—was not cost effective in comparison with eradication.

The comparison of expected costs and disease losses for a successful eradication program with losses to be expected if the program was discontinued showed a benefit/cost ratio of 13.2 when projected costs and losses were discounted at 10 percent. In dollar terms this means a \$13.20 savings in expense due to hog cholera for every \$1 invested in a successful eradication effort. A more conservative discount rate (6 percent) resulted in an even higher ratio of \$21.10 in benefits for every \$1 of cost.

As the program did proceed to final eradication along the lines predicted when the 1970 analysis was prepared, it is evident that benefits from the program were many times higher than costs of the program. As time goes on, these economic benefits will continue to accrue. The \$57.4 million annual hog cholera cost just prior to the program would, with inflation, have been much higher in 1978 if the disease had not been eradicated. Instead, the cost of hog cholera to swine producers is now zero—and will remain at zero in succeeding years. There will be some expenditure of public funds for investigating suspicious swine sicknesses and as part of the ongoing disease surveillance program at U.S. borders and international ports of entry. If, in spite of these precautions, hog cholera should reenter the country, there will be the expense of stamping out the outbreak. These costs, however, will be minute in comparison with the continuing economic burden of the disease if it had not been eradicated.

There are other benefits in addition to the measurable economic return. An economic factor not taken into account in the benefit/cost projection is increased opportunity for U.S. pork products in

the international market. In 1962 there were 12 countries that prohibited entry of U.S. pork because of hog cholera. This potential market was then estimated at \$20 million annually. While this country cannot be expected to capture it all, the United States now has the option to compete for these sales.

The hog cholera program also improved the ability of this country to combat introductions of foreign diseases of livestock and poultry. During the years of the hog cholera campaign, hundreds of Federal and State veterinarians and other field personnel had direct experience with the rigorous measures necessary in a large scale stamping out program. The logistical problems of safe disposition of large numbers of condemned animals, of organizing strict quarantine and inspection over large areas, of quickly establishing field laboratories, and of meeting the many concerns of affected livestock owners had become a part of their career backgrounds. Many of these veterinarians also gained wide experience in field epidemiology. The emergency disease organization of Veterinary Services, APHIS, USDA was heavily involved in the latter years of the program and thus refined its operating procedures through wide and difficult experience. This extensive practical knowledge can be quickly and directly applied to combat future introduction of any foreign animal disease.

An additional benefit, in relation to protection against exotic disease, lies in the much improved position of the United States in regard to African swine fever following eradication of hog cholera.

African swine fever (ASF) is a swine disease that cannot be distinguished clinically from hog cholera. It is now emerging as the most dangerous exotic disease threat to the United States swine industry. There is no known treatment nor is there an effective vaccine. Most affected swine die. In the last 20 years, the disease has moved out of Africa into Portugal, Spain, Italy, Sardinia, and Malta. France had two introductions that were stamped out. Cuba, 90 miles from Florida, had a serious outbreak in 1971 that was eliminated at a cost of one third of that country's swine population.

In June 1978, ASF appeared in Brazil and is currently spreading there. Later, the disease was found in the Dominican Republic and Haiti—just over 60 miles from Puerto Rico. This has necessitated an ongoing surveillance program in Puerto Rico.

If hog cholera had continued in the United States, it would have been easy to initially mistake an introduction of ASF as just another case of hog

cholera, making ASF much more difficult to recognize and eradicate quickly. Now, with both diseases exotic to the United States, any swine illness clinically suspected of either will result in immediate emergency action.

In Retrospect

Although all large-scale disease eradication programs face a mixture of technical problems and differing personal attitudes, there was an additional unique situation facing those concerned with hog cholera eradication. This was the task of changing the traditions, perceptions, and economic interests that had built up around the disease since the mid-19th century. Hog cholera had become more deeply rooted, over a longer period of time, than any acute, highly fatal disease of livestock previously tackled in this country.

While there were technical problems to be solved when the program started, these did not appear to be insurmountable. As the program progressed, the professionals in regulatory veterinary medicine and scientists in and out of government did in fact provide the necessary technical solutions.

The same confidence could not be assumed for the obstacles resulting from differing personal attitudes. However, as the program developed, these also were overcome with sufficient timeliness to permit continuing progress and final eradication. Although conclusions on why this happened are necessarily subjective, they can, in retrospect, be drawn.

The points below were key supports to the implementation of the technical steps needed to eradicate hog cholera from the United States:

- Governmental agencies alone did not try to create or sustain demand for an eradication program.
- Active advisory groups, representing a wide spectrum of interests, were in operation throughout the program.
- Advisory groups were working groups, not honorary bodies. Members stayed interested because they were asked to use their talents.
- Members were strong and informed leaders in their own fields of activity and were able to carry out a prime function of advisory groups, which is to challenge policies as recommended and conducted by the governmental agencies.
- Members were drawn from groups strongly supporting the program and those not so enthusiastic.

- The program maintained flexibility. The design permitted individual States to move forward in line with resources. Changes were made to fit circumstances without losing sight of the final goal.
- Momentum was maintained, even if a change in approach was required to do so.
- Due to close involvement of many groups in the program, policies of consequence could not be initiated or altered by a single group or agency. Because review and discussion in advance of change was required, the result was sufficient understanding and consensus to permit steady progress.

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This listing is primarily directed to information bearing on the hog cholera eradication program. While it includes major data sources used in preparing the text, it does not include the many ongoing internal reports generated during the program years. Most of these are summarized in the various annual status reports that are listed below. Also omitted are listings of the many informational bulletins, releases, and press reports accumulated by the Information Divisions of the Agricultural Research Service (USDA) and the Animal and Plant Health Inspection Service (USDA) and made available to the writer. The listing represents only a small fraction of the total published material on hog cholera and is not intended as a comprehensive bibliography on the disease.

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